DEPARTMENT OF BIOTECHNOLOGY

ANNA UNIVERSITY, CHENNAI

Vision:

The Department of Biotechnology is committed to evolve as a world class science and technology centre by integrating quality and ethics in teaching and research.

Mission:

The mission of the department is

- To provide students a unique and multidisciplinary learning experience that will foster the young minds to develop as a researcher, entrepreneur etc.
- To enhance academic and industrial collaborative research initiatives for the development of biotechnological, food and therapeutic products.
- To emphasise and equip the students towards innovative industrial and research updates.
- To serve the society with utmost commitment, integrity, enthusiasm, and dedication.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ANNA UNIVERSITY, CHENNAI: 600 025

UNIVERSITY DEPARTMENTS

M.TECH BIOPHARMACEUTICAL TECHNOLOGY

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To prepare students to excel in research and to succeed in biopharmaceutical technology profession through global, rigorous post graduate education.
2. To provide students with a solid foundation in statistical, scientific and engineering fundamentals required to solve biopharmaceutical related problems.
3. To train students with good scientific and technical knowledge so as to comprehend, analyze, design, and create novel products and solutions for the health related problems.
4. To inculcate students in scientific and professional ethics, scientific communication skills, teamwork skills, multidisciplinary approach, and an ability to address health related problems to broader social context.
5. To provide students with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful Scientific and professional career.

2. PROGRAMME OUTCOMES (POs):

PO	Post Graduate Attribute	Program Outcome
1.	Engineering Knowledge	Students will demonstrate knowledge of statistics, science and technology.
2.	Problem Analysis	Students will demonstrate an ability to identify formulate and solve problems in industry and research.
3.	Design/development of solutions	Students will demonstrate an ability to design and conduct experiments, analyze and interpret data.
4.	Conduct investigations of complex Problems	Students will demonstrate an ability to design an experiment, component or process as per needs and specifications.
5.	Modern tool usage	Students will demonstrate skills to employ modern technology, software and equipment to analyze problems. The post graduate will be adept at performing experiments in modern biopharmaceutical and biotech industries where advanced tools would be used for developing health care solutions
6.	The engineer and society	Students will show the understanding of the impact of pharmaceutical technology on the society and also will be aware of contemporary issues. To conduct themselves to uphold the professional and social obligations in health care needs of the society
7.	Environment and sustainability	Be aware of the implications of the industrial by-products generated and will be responsible in designing systems with environmental consciousness and sustainable development.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

8.	Ethics	Students will demonstrate knowledge of professional and ethical responsibilities to interact in industry, business and society in a professional and ethical manner to uphold the morality of the society. They will demonstrate the ability and requirements to sense the needs of the nation and their role in nation building.
9.	Individual and team work	Function in a multidisciplinary team
10.	Communication	The student is trained in both verbal and written communication in English needed to convey the research ideas to industrial and agencies who need skilled man power inputs.
11.	Project management and finance	Having undergone a project the student is capable of designing, performing and interpreting the results of their experiment. Thereby implement cost effective and improved system
12.	Life-long learning	Graduates will develop confidence for self e ducation and ability for life-long learning.

3. MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVE WITH PROGRAMME OUTCOMES

	PROGRAMME OUTCOMES											
PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**
1.	✔	✔	✔	✔								
2.	✔	✔										
3.		✔	✔	✔		✔				✔	✔	✔
4.								✔	✔		✔	
5.							✔	✔		✔		

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

4. MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

			PROGRAMME OUTCOMES (POs)											
		SUBJECTS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
YEAR 1	SEMESTER I	Drug Regulatory, Quality and Safety management	2	1	1	2	-	1	2	2	2	1	1	2
		Formulation of biopharmaceuticals	3	3	3	2	3	2	1	2	2	1	2	3
		Molecular Pharmacology	1	1	-	-	-	-	1	-	-	-	-	2
		Professional Elective I												
		Professional Elective II												
		Research Methodology and IPR												
		Audit Courses I												
		Professional Elective III												
		Formulation and Analytical Techniques in Biopharmaceutical Technology	3	3	3	2	3	3	1	2	2	1	3	3
	SEMESTER II	Pharmacokinetics and Pharmacodynamics	3	3	3	3	3	3	2	1	2	1	3	3
		Immunopharmacology	3	3	3	3	3	3	1	1	1	–	2	3
		Advances in Animal biotechnology	2	2	2	1	2	1	1	1	1	-	1	1
		Professional Elective IV												
		Professional Elective V												
		Audit Courses II												
		Open Elective												

		Immunopharmacology Laboratory	3	3	2	2	3	2	2	1	1	-	-	1
		Mini project with seminar	1	3	2	3	3	3	2	3	2	3	2	3
YEAR 2	SEMESTER III	Sophisticated Analytical Techniques In Biotechnology Laboratory	-	3	3	2	3	3	2	2	1	-	-	-
		Animal biotechnology Laboratory	3	2	2	2	2	1	1	-	1	-	1	2
		Computational methods in pharmaceutics Laboratory	3	2	3	3	2	3	–	–	–	–	–	–
		Project Phase – I	2	3	2	2	2	1	-	2	2	2	1	2
	SEMESTER IV	Project Phase – II	2	3	2	2	2	1	-	2	2	2	1	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

M.TECH BIOPHARMACEUTICAL TECHNOLOGY

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM CURRICULUM AND

SYLLABI FOR I TO IV SEMESTERS

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	BP5101	Drug Regulatory, Quality and Safety management	PCC	3	0	0	3	3
2	BP5102	Formulation of biopharmaceuticals	PCC	3	0	0	3	3
3	BP5103	Molecular Pharmacology	PCC	3	0	0	3	3
4		Professional Elective I	PEC	3	0	0	3	3
5		Professional Elective II	PEC	3	0	0	3	3
6		Professional Elective III	PEC	3	0	0	3	3
7	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
8		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
9	BP5111	Formulation and Dosage form Analytical Techniques in Biopharmaceutical Technology	PCC	0	0	4	4	2
			TOTAL	**22**	**0**	**4**	**26**	**22**

*Audit Course is Optional

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	BP5201	Pharmacokinetics and Pharmacodynamics	PCC	3	0	0	3	3
2	BP5202	Immunopharmacology	PCC	3	0	0	3	3
3	BT5251	Advances in animal biotechnology	PCC	3	0	0	3	3
4		Professional Elective IV	PEC	3	0	0	3	3
5		Professional Elective V	PEC	3	0	0	3	3
6		Audit Course – II*	AC	2	0	0	2	0
7		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
8	BP5211	Immunopharmacology Laboratory	PCC	0	0	6	6	3
9	BP5212	Mini project with seminar	EEC	0	1	2	3	2
			TOTAL	**20**	**1**	**8**	**29**	**23**

*Audit Course is Optional

SEMESTER III

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1	BT5361	Sophisticated Analytical Techniques In Biotechnology Laboratory	PCC	0	0	6	6	3
2	BP5311	Animal biotechnology Laboratory	PCC	0	0	6	6	3
3	BP5312	Computational methods in pharmaceutics Laboratory	PCC	1	0	4	5	3
4	BP5313	Project Phase – I	EEC	0	0	12	12	6
			TOTAL	**1**	**0**	**26**	**29**	**15**

SEMESTER IV

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	BP5411	Project Phase – II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO OF CREDITS: 72

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PROFESSIONAL CORE COURSES (PCC)

S. NO.	CODE	COURSE TITLE	L	T	P	CREDITS	SEMESTER
1.	BP5101	Drug Regulatory, Quality and Safety management	3	0	0	3	I
2.	BP5102	Formulation of biopharmaceuticals	3	0	0	3	I
3.	BP5103	Molecular Pharmacology	3	0	0	3	I
4.	BP5111	Formulation and Dosage form Analytical Techniques in Biopharmaceutical Technology	0	0	4	2	I
5.	BP5201	Pharmacokinetics and Pharmacodynamics	3	0	0	3	II
6.	BP5202	Immunopharmacology	3	0	0	3	II
7.	BT5251	Advances in animal biotechnology	3	0	0	3	II
8.	BP5211	Immunopharmacology Laboratory	0	0	6	3	II
9.	BT5361	Sophisticated Analytical Techniques In Biotechnology Laboratory	0	0	6	3	III
10.	BP5311	Animal biotechnology Laboratory	0	0	6	3	III
11.	BP5312	Computational methods in pharmaceutics Laboratory	1	0	4	3	III

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PROFESSIONAL ELECTIVES (PEC)

S. NO.	CODE NO	COURSE TITLE	CATE GORY	TOTAL CONTACT PERIODS	L	T	P	CREDITS
1	BP5072	Biogenerics and Biopharmaceuticals	PEC	3	3	0	0	3
2	BP5001	Advances in Omics Sciences and Technology	PEC	3	3	0	0	3
3	BT5012	Molecular pathogenesis of infectious diseases	PEC	3	3	0	0	3
4	BT5072	Enzyme Engineering And Technology	PEC	3	3	0	0	3
5	BP5002	Bioconjugate Technology and Applications	PEC	3	3	0	0	3
6	BP5003	Chemistry of Natural Products	PEC	3	3	0	0	3
7	BP5073	Clinical Trials and Bioethics	PEC	3	3	0	0	3
8	BP5004	Conventional and rational Drug Discovery Strategies	PEC	3	3	0	0	3
9	BP5005	Metabolic Process and Engineering	PEC	3	3	0	0	3
10	BP5074	Molecular Medicine and Mechanism	PEC	3	3	0	0	3
11	BT5073	Nanobiotechnology	PEC	3	3	0	0	3
12	BP5071	Advances in Pharmacogenomics	PEC	3	3	0	0	3
13	BT5071	Applied Statistics for Biologists	PEC	3	2	1	0	3
14	BT5010	Techniques in Molecular Biology and Genetic Engineering	PEC	3	3	0	0	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO.	CODE NO.	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	RM5151	Research Methodology and IPR	2	0	0	2	1

OPEN ELECTIVE COURSES [OEC]*

*(Out of 6 Courses one Course must be selected)

S.NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	OE5091	Business Data Analytics	3	0	0	3	3
2.	OE5092	Industrial Safety	3	0	0	3	3
3.	OE5093	Operations Research	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	3	0	0	3	3
5.	OE5095	Composite Materials	3	0	0	3	3
6.	OE5096	Waste to Energy	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lectur	Tutorial	Practical		
1.	AX5091	English for Research Paper Writing	2	0	0	0	1/2
2.	AX5092	Disaster Management	2	0	0	0	
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0	
4.	AX5094	Value Education	2	0	0	0	
5.	AX5095	Constitution of India	2	0	0	0	
6.	AX5096	Pedagogy Studies	2	0	0	0	
7.	AX5097	Stress Management by Yoga	2	0	0	0	
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0	
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0	

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	BP5212	Mini project with seminar	0	1	2	2	II
2.	BP5313	Project Phase – I	0	0	12	6	III
3.	BP5411	Project Phase – II	0	0	24	12	IV

SUMMARY

CATEGORY	SEM 1	SEM 2	SEM 3	SEM 4	Total
PCC	11	12	9		32
PEC	9	6			15
RMC	2				2
AC (Non Credit)	0	0			0
OEC		3			3
EEC		2	6	12	20
Total Credit	22	23	15	12	**72**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SYLLABI

SEMESTER I

BP5101 DRUG REGULATORY, QUALITY AND SAFETY MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

The course aims to,

- Enable the students to learn about the various agencies in drug regulatory affairs in India and at International level.
- Acquire knowledge about intellectual property rights, drug development approval processes and safety management.

UNIT I INTRODUCTION TO DRUG REGULATORY LAWS 9

Drugs and Cosmetics Act 1940 and its rules 1945National Pharmaceutical Pricing Authority (NPPA),The Environmental Protection Act-1986&Occupational Safety and Health Administration (OSHA),Consumer Protection Act-1986,Factories Act-1948 and Pollution control Act-1989,The Drugs (Prices Controls) Order, 1955. The Indian Patents and Designs, Act 1970, Magic Remedies and Objectionable advertisements Act. h. Prevention of Food Adulteration Act 1954 (5 hrs) i. Intellectual Property Rights: • ICH guidelines for clinical trials, therapeutic drug monitoring and bioequivalence. • Exclusive marketing rights.

UNIT II PHARMACOPOEIA 8

Descriptions & Monographs; Standards and Specifications; Testing of Drugs; Various Countries Pharmacopoeias; Indian, British, U.S, European, Japanese.

UNIT III CGMPS & REGULATORY RECORDS 10

cGMP concepts – Development, Manufacturing Record, Analytical &process Validation, Equipment & utility Qualification and Calibration, Personnel procedures; Regulatory bodies & requirements - Indian FDA, WHO GMP ; U.S. FDA, U.K. MCA, Australian TGA, Japanese PMDA. Drug dossier contents - CTD (CMC section) & data.

UNIT IV DRUG DEVELOPMENT APPROVAL PROCESS/CLINICAL TRIALS 8

Drug development stages, FDA guidelines on IND, new drug approvals (NDA), ANDA approvals. European regulatory agency, types of filing process (Centralized, decentralized, RMS countries), Regulation of preclinical studies, Design of clinical studies CFR / ICH / EU GCP guidelines; Schedule-Y, pre-clinical study requirements, clinical trial phases, types of trials, bioethics and stakeholders, Bioavailability & Bioequivalence studies.

UNIT V PRODUCT MANAGEMENT AND QUALITY ASSURANCE 10

GLP, ISO 9000, TQM, Quality Review and Quality Documentation, Regulatory control, regulatory drug analysis, interpretation of analytical data,Basic requirements - design of product, facility, equipment selection and personnel.Industrial hazards due to fire, accident, mechanical, electrical equipment, monitoring and preventive system (Safety measures including insurance).Effluent testing, treatment and waste management.Safety and Environmental Control.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 Enable the students to learn the principles of drug regulation.

CO2 Insight about current regulatory process in the pharmaceutical industry.

CO3 Assure the learning of quality standards in pharmaceutical industry.

TEXTBOOKS AND REFERENCES

1. Abraham, John and Smith, H.W. “Regulation of the Pharmaceutical Industry”, Palgrave, Macmillan, 2003.
2. Weinberg, Sandy “Good Laboratory Practice Regulations” 4th Edition, Marcel Dekker, 2007.
3. Gad, Shayne C. “Drug Safety Evaluation”, Wiley-Interscience, 3rd Edition, 2016.
4. Malik, Vijay “Drugs and Cosmetics Act, 1940”. EBC Publishing Co, 2018.
5. “Quality Assurance of Pharmaceuticals: A Compendium of Guidelines and Related Materials”, Vol. I & II, World Health Organization and Pharma Syndicate, 2002.
6. Berry, Ira R. and Harpaz, Daniel “Validation of Active Pharmaceutical Ingredients”, 2nd Edition, CRC Press, 2001.
7. British Pharmacopoeia, Andesite Press, 2017.
8. United States Pharmacopoeia,2019

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Enable the students to learn the principles of drug regulation	2	1	1	2	-	1	2	2	2	-	1	2
CO2	Insight about current regulatory process in the pharmaceutical industry	2	1	1	2	-	1	2	2	2	-	1	2
CO3	Assure the learning of quality standards in pharmaceutical industry	2	2	2	2	-	1	1	1	2	1	2	1
Overall CO		2	1	1	2	-	1	2	2	2	1	1	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BP5102 FORMULATION OF BIOPHARMACEUTICALS L T P C
3 0 0 3

OBJECTIVES

The course aims to,

- Enable the students to acquire theoretical knowledge in pharmaceutical dosage forms
- Understand the theoretical principles with application oriented problems.

UNIT I INTRODUCTION TO DOSAGE FORMS 5

History & Evolution; Definitions and Classification of Dosage forms and routes of administration (Oral, Parenteral, Topical, Rectal and Nasal), Pharmacokinetics/Pharmacodynamics parameters for Dosage form development

UNIT II PREFORMULATION AND STABILITY STUDIES 9

Physical properties of drugs - physical form, polymorphism, particle size, shape, density, wetting, dielectric constant, solubility, dissolution, organoleptic property and their effect on formulation, stability and bioavailability. Study of chemical properties of drugs like hydrolysis, oxidation, reduction, racemization, polymerization, etc. and their influence on formulation and stability of products.Stabilization and stability testing protocol for various pharmaceutical products.

UNIT III SOLID DOSAGE FORMS 9

Capsules: Materials for production of hard/Soft gelatin capsules, size of capsules and method of capsule filling. Importance of base absorption, manufacturing, quality control, stability and storage of capsule dosage forms. Micro-encapsulation- Classification, Methods of preparation and Evaluation of microcapsules. Tablets : Classification, tablet excipients,Mixing; Milling; Drying; Compression; Coating; Filling; Sealing; Solubility; Filtration,Clarification, Sieving; granulation technology, tablet compression and machinery, processing problems and evaluation. Coating-Types, materials for coating, formulation, equipment, film defects and evaluation of coated tablets.

UNIT IV LIQUID, SEMI-SOLID AND AEROSOL DOSAGE FORMS 12

Liquid Dosage forms: Additives in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizer, colors, flavors, manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions official in pharmacopoeia. Semisolid Dosage Forms: Mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection. General formulation of semisolids, clear gels, formulations of semisolids like Cream, Gel, Paste; Suppositories, manufacturing procedure, evaluation and packaging. Aerosols:Types of propellants, general formulation, manufacturing, packaging methods, pharmaceutical applications and evaluation.

UNIT V PARENTERALS AND NOVEL DRUG DELIVERY SYSTEMS 10

Parenteral; Liquids,(Solutions, Suspensions and Emulsions); Nasal; Ophthalmic and Optic Preparations; Packaging biopharmaceutical dosage design & delivery. Sustained release and controlled release Pharmaceuticals – Classification and construction of products and evaluation. Novel Drug delivery systems – Transdermal delivery systems, Osmotic drug delivery systems, Liposomes, Nanoparticles.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 have learnt Pharmacokinetics/Pharmacodynamics parameters for dosage form development.
CO2 learn formulation of various dosage forms of drugs.
CO3 learn evaluation of various dosage forms of drugs.
CO4 have knowledge of technological advancements to improve formulations at the completion of course.

TEXTBOOKS AND REFERENCES

1. Ansel, H.C. "Pharmaceutical Dosage Forms and Drug Delivery Systems", 11th Edition, Lippincott Williams & Wilkins, 2018.
2. Tipnis, H.P. "Bioavailability and Bioequivalence: An Update". New Age International, 1996.
3. Lieberman, H.A. "Pharmaceutical Dosage Forms: Tablets". Vol.1-3, 2ndEdition, Marcel Dekker, 2005.
4. Lieberman, H.A. "Pharmaceutical Dosage Forms: Parenteral Medications", Vol.1-3, 2nd Edition, Marcel Dekker, 2005.
5. Lieberman, H.A. "Pharmaceutical Dosage Forms: Disperse Systems", Vol.1-3, 2nd Edition,Marcel Dekker, 2005.
6. Lippincott, "Remington's The Science and Practice of Pharmacy", Vo.1 & 2, 20th Edition, Williams& Wilkins, 2004.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	learnt Pharmacokinetics/Pharmacodynamics parameters for Dosage form development.	3	3	3	2	3	3	-	-	2	-	2	3
CO2	learn formulation of various dosage forms of drugs.	2	3	2	2	3	2	-	2	2	-	2	2
CO3	learn evaluation of various dosage forms of drugs.	2	2	2	2	2	2	-	2	2	-	2	2
CO4	have knowledge of technological advancements to improve formulations at the completion of course.	3	3	3	2	3	3	1	1	2	1	3	3
Overall CO		3	3	3	2	3	2	1	2	2	1	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BP5103 **MOLECULAR PHARMACOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to,

- study the mechanism of action of drugs at molecular level and different molecular targets.
- provide advanced knowledge about pharmacology of drugs and toxicology.

UNIT I OVERVIEW OF DRUGS ACTING ON VARIOUS SYSTEMS 10

Central nervous system, Autonomic nervous system, Autacoids,Analgesic, Antipyretic, and Anti-inflammatory Agents, Renal and cardiovascular system, Anti Infective agents, Hormones, Hematopoietic agents, Immunopharmacology.

UNIT II RECEPTORS AND THEIR MODE OF ACTION 8

Angiotensin receptors Excitatory amino acid receptors Kinin receptor, Adrenoceptors, Low molecular weight heparins, hirudins and GP IIB/IIIa receptor antagonists, Cholinergicreceptors, Dopamine receptors, Serotonin receptors, Hormone receptors, GABA and Benzodiazepine receptors, Opioid receptors, Purinergic receptors, Glutamate receptors.

UNIT III BIOACTIVE MOLECULES 8

Endogenous bioactive molecules: Cytokines, neuropeptides and their modulators, neurosteroids, nitric oxide, phosphodiesterase enzyme and protein kinase C, arachidonic acid metabolites, COX-2 regulators and their role in inflammation, endothelium derived vascular substances (NO, endothelins) and their modulators. Pharmacology of atrial peptides, reactive oxygen intermediates, antioxidants and their therapeutic implications.

UNIT IV MOLECULARMECHANISM OF DRUG ACTION 10

Receptor occupancy and cellular signaling systems such as G-proteins, cyclic nucleotides, calcium and calcium binding proteins, phosphatidylinositol. Ion channels and their modulators.: Basic concepts in molecular pharmacology: agonists, antagonists and inverse agonists; potency, intrinsic activity and efficacy; mechanisms of signaling and its inhibition; measurement of binding and response. Preparation, G protein-coupled receptors, G proteins and effectors, Mechanism of G protein-mediated signaling, Wnt, hedgehog and notch, Intrinsic tyrosine kinases, Biophysical characterisation of ion flux, Voltage-gated ion channels.

UNIT V TOXICOLOGY 9

Principles of toxicology, Physicochemical, Biochemical and genetic basis of toxicity, principles of toxicokinetics, mutagenesis and carcinogenesis, Acute, sub-acute and chronic toxicity studies according to guidelines. Guidelines and regulatory agencies – CPCSEA, OECD, FDA, ICH, FHSA, EPA, EEC, WHO etc.,

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1 to learn the molecular basis of drug action.

CO2 provide an insight about bioactive molecules in pharmacology.

CO3 acquire knowledge on toxicology.

TEXT BOOKS AND REFERENCES

1. Satoskar, "Pharmacology and Therapeutics", Elsevier India, 25th edition, 2017.
2. Tripathi, K.D. "Medical Pharmacology", Jaypee Brothers Medical Publishers, 8th edition, 2018.
3. Karen Whalen, "Lippincott Illustrated Reviews: Pharmacology", Lippincott Williams and Wilkins, 6th Edition, 2014.
4. Rang, M.P, Dale M.M, Reter J.M, "Pharmacology", Churchill Livingstone, 8th revised edition, 2015.
5. Laurence Brunton , Bjorn Knollmann , RandaHilal-Dandan, "Goodman and Gilman's: The Pharmacological basis of therapeutics", McGraw-Hill Education / Medical, 13th edition, 2017.
6. Kulkarni S.K., "Handbook of Experimental Pharmacology", 2016
7. Katzung, B.G., "Basic and Clinical Pharmacology", 13th Edition, McGraw Hill 2015.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	To enable the students to learn the molecular basis of drug action	1	1	-	-	-	-	1	-	-	-	-	2
CO2	To provide an insight about bioactive molecules in pharmacology	1	1	-	-	-	-	1	-	-	-	-	2
CO3	To acquire knowledge on toxicology	1	1	-	-	-	-	1	-	-	-	-	2
Overall CO		1	1	-	-	-	-	1	-	-	-	-	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

RM5151 **RESEARCH METHODOLOGY AND IPR** **LT P C**
2 0 0 2

COURSE OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc.
Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

COURCE OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BP5111 **FORMULATION AND ANALYTICAL TECHNIQUES IN BIO-PHARMACEUTICAL TECHNOLOGY** **L T P C 0 0 4 2**

OBJECTIVES

The course aims to,

- provide hands on experience on different forms of drug formulation
- learn the analytical methods available for evaluation of pharmaceuticals.

PART I: FORMULATION EXPERIMENTS

1. Preparation of Nano Emulsions.
2. Preparation of Lyophilised powder
3. Preparation of solid dosage forms (Eg. Granules, Tablets, Capsules)
4. Preparation of liquid dosage forms (Eg. True Solutions, mixtures, Elixirs)
5. Preparation of biphasic dosage forms (Eg. Emulsion, Suspension)
6. Preparation of semisolid dosage forms (Eg. Ointments, Creams, Gels, lotions
7. Preparation of Parenteral and ophthalmic formulations
8. Preparation of specialized dosage forms (Eg. Suppositories, Patches)

PART II: ANALYTICAL METHODS FOR EVALUATION OF PHARMACEUTICALS BASED ON PHARMACOPOEIAS

1. Disintegration test, weight variation.
2. Particulate matter, Transmittance of light, Viscosity, Extractables and leachable, Freeze-Thaw test.
3. pH, Dissolution, Sedimentation volume, Rheological method, Zeta potential measurement, Freeze-Thaw test, Extractables and leachable.
4. Particle size distribution , In-vitro release testing, Extractables and leachable, Freeze-Thaw test.
5. Leaker test, Pyrogen test, Sterility, Particulate matter, Preservative efficacy test, Extractables and leachable.
6. Sprays & Inhalations – Valve discharge rate, Spray pattern & Plume geometry, Dosage with metered valves, Foam stability.
7. Net content and Weight loss, pH, Osmolality.
8. Stability testing for all dosage forms.

TOTAL :60 PERIODS

EQUIPMENTS REQUIRED

1. Mortar and Pestle
2. Sieves of all sizes
3. Granulator
4. Punching machine
5. Capsule filler
6. Disintegration, dissolution and friability testing apparatus
7. Formulation reagents (surface acting agents, glidants, diluents etc,)
8. pH meter, physical balances

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 understand the development of different dosage forms of drugs.

CO2 learn the evaluation of various dosage forms of drugs.

CO3 get knowledge of developing new formulation.

CO4 find out the stability of the dosage forms

CO5 have hands on experience in dosage form formulation and pursue a career in industry

TEXTBOOKS AND REFERENCES

1. Ansel, H.C. "Pharmaceutical Dosage Forms and Drug Delivery Systems", 7th Edition, Lippincott Williams & Wilkins, 2000.
2. Avis, K.E., "Pharmaceutical Dosage Forms: Parenteral Medications", (Vol.I, II & III) 2nd Rev. Edition, Marcel Dekker, 1992.
3. Lachman, Leon "The Theory And Practice of Industrial Pharmacy", 4th Edition, Varghese Publishing House, 2013.
4. Lieberman, H.A.., "Pharmaceutical Dosage Forms: Disperse Systems" (Vol.I, II & III) 2nd Rev. Edition, Marcel Dekker, 1996.
5. Lieberman, H.A. "Pharmaceutical Dosage Forms: Tablets" (Vol. I, II & III) 2nd Edition, Marcel Dekker, 1989.
6. USP NF, guidelines: http://www.usp.org, https://www.uspnf.com, & http://www.fda.gov.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	understand the development of different dosage forms of drugs.	3	3	3	2	3	3	-	-	2	-	3	3
CO2	learn the evaluation of various dosage forms of drugs.	2	3	2	2	3	2	-	2	2	-	3	2
CO3	get knowledge of developing new formulation.	2	2	2	2	2	3	-	2	2	-	3	3
CO4	find out the stability of the dosage forms	3	3	3	2	3	2	-	2	2	-	2	3
CO5	have hands on experience in dosage form formulation and pursue a career in industry	3	3	3	2	3	3	1	1	2	1	3	3
Overall CO		3	3	3	2	3	3	1	2	2	1	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER II

BP5201	PHARMACOKINETICS AND PHARMACODYNAMICS	L T P C
		3 0 0 3

OBJECTIVES

The course aims to,

- enable the students to understand the essential principles of pharmacokinetics.
- understand the pharmacodynamics required for the development of therapeutic agents.

UNIT I FUNDAMENTALS ON DRUG ABSORPTION AND DISTRIBUTION 9

Definitions, various routes of administration with advantages / disadvantages, bioavailability concepts in drug absorption and distribution, theories of drug dissolution, drug partition hypothesis,permeability and distribution of drugs, perfusion rate and volume of distribution, protein binding of drugs, kinetics of drug binding, various factors that affect drug absorption and distribution, drug interactions in the level of drug absorption and distribution.

UNIT II FUNDAMENTALS OF DRUG METABOLISM AND EXCRETION 9

Biotransformation of drugs, pathways and enzymes of drug metabolism, Phase I and Phase II, drugs excretion –renal and non-renal routes, various factors that affect drug metabolism and excretion, prodrugs, drug interactions in the level of drug metabolism and excretion, bioavailability concepts in drug metabolism and excretion.

UNIT III PHARMACOKINETIC INVESTIGATION AND EVALUATION 9

Concept of therapeutic concentration, time-profile, rates and various order of reactions (first, zero, mixed), Michaelis-Menton kinetics, differential equations for a simple pharmacokinetic models, compartment models (one, two, multi, open models), definition and calculation of parameters such as drug half-life, of Drugs, Volume of Distribution, and bioavailability (AUC) and their application to compartment models and kinetics of IV Bolus administration, comparison between bioavailability and bioequivalence.

UNIT IV PHARMACODYNAMIC FUNDAMENTALS 10

Definitions – agonist/antagonist, antagonism as a mechanism of drug action, classification of antagonists, drug-receptor interactions, factors affecting drug-target interactions, law of mass action applied to drugs, quantifying drug-target interactions: dose-response relationships - graded dose and quantal dose-responses; molecular mechanisms mediating drug action, receptor coupling and transduction mechanisms, intracellular transduction mechanisms, second messenger systems, amplification of drug responses, factors modifying drug responses.

UNIT V APPLICATION OF PD/PK PRINCIPLES IN DOSAGE FORM DEVELOPMENT 8

Regimens for dosage form design, concentration response relationships, individualization therapeutics, classification of controlled release formulations and novel drug delivery (oral, parenteral, trans-dermal, ophthalmic and intrauterine) systems, bioavailability testing of novel release formulations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 Understand the fundamentals of drug absorptions and distribution.

CO2 Understand the fundamentals of drug metabolism and excretion.

CO3 Understand the ADME using various pharmacokinetics models.

CO4 Understand the various mechanism of drug action.

CO5 understand and learnt the fundamentals drug PK/PD that will enable them for research and application in dosage form development.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS AND REFERENCES

1. Brahmankar, D.M., “Biopharmaceutical and Pharmacokinetics:A Treatise”, VallabhPrakashan, 2015
2. Notari, R.E., “Biopharmaceutics and Clinical Pharmacokinetics: An Introduction”, 4th Edition, Marcel Deckker, 2005.
3. Schoenwald, R.D., “Pharmacokinetics in Drug Discovery and Development”, CRC Press, 2002.
4. Oliver Kayser, Rainer H. Müller, “Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications”, Wiley-VCH publications, 2nd edition, 2012.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	understand the fundamentals of drug absorptions and distribution.	2	3	2	2	1	1	-	-	1	-	2	3
CO2	understand the fundamentals of drug metabolism and excretion.	2	3	2	2	1	1	-	2	1	-	2	2
CO3	understand the ADME using various pharmacokinetics models.	3	3	3	3	2	1	-	2	-	-	2	2
CO4	Understand the various mechanism of drugs action.	3	3	2	2	3	1	-	2	1	-	2	3
CO5	understand and learnt the fundamentals drug PK/PD that will enable them for research and application in dosage form development.	3	3	3	3	3	3	2	1	2	1	3	3
Overall CO		3	3	2	2	2	1	2	2	1	1	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BP5202 **IMMUNOPHARMACOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to,

- Enhance the knowledge pertaining to the function and diseases of the human immune system.
- Learn the strategies of development, classification and application of immunotherapeutic drugs, vaccines and biologicals.

UNIT I PHARMACOLOGY OF AGENTS AFFECTING IMMUNE SYSTEM 9

Overview of discovery and development of immuno-drugs.and various therapeutic pathways and targets of immune system, immune cell and organ classification, neuro humoral regulation of immune responses, complement pathways, cytokine classification and activation, T-cell and B-cell development, Principles of basic and clinical pharmacokinetics and pharmacodynamics of immune drugs; bioassay and animal models for immune drug validation.

UNIT II VACCINOLOGY AND IMMUNODIAGNOSTICS 9

T and B epitopes classification, adjuvant and hapten classification, immuno-screening of antigens, vaccine formulation technology, vaccine production and validation, recombinant vaccines, peptide vaccines, reverse vaccinology, therapeutic vaccines. Monoclonal antibody production and application, antibody engineering, scFv Antibodies, immunoconjugates, immunotoxins. Immunodiagnostics – ELISA types, principle/development of Rapid immuno diagnostic tests.

UNIT III IMMUNO THERAPEUTICS AND IMMUNE CANCER THERAPEUTICS 9

(WHO) Anatomical Therapeutic Chemical (ATC) Classification of drugs affecting the immune system (L, L01, L02, L03, L04), therapeutic use of cytokines, classification – immunostimulators; immunomodulators, therapeutic Mabs classification and formulation.Cancer vaccines, CAR T-cell therapy, immune check-point inhibitors.

UNIT IV TRANSPLANTATION 9

Laws of transplantation, host vs graft and graft versus host reactions; HLA Classification, drugs for immunosuppressive therapy: corticosteroids, Antimetabolites and calcineurin inhibitors, immunosuppressive drugs and adjuvant therapies.

UNIT V IMMUNOLOGY OF ALLERGY 9

Classification of hypersensitivity reactions, Classification of allergens, Adverse drug reactions, Drug Hypersensitivity – pharmacologic perspective, immunologic perspective, Off-target toxicity, Cellular Basis, Chemical Basis – The Hapten/pro hapten hypothesis, The Danger theory, The pi concept, therapy and prevention of allergies;. Pharmacology of antihistamines, classification, histamine stabilizers, anti-inflammatory agents, anti-rheumatoid drugs, Disease-modifying antirheumatic drugs (DMARDs).

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 Understand the diseases impacted in the domain of humoral/cellular immune responses.

CO2 Learn the pharmacology of drugs affecting the immune system and vice versa.

CO3 Learn the research strategies of developing and evaluating immunotherapeutics for emerging diseases.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS AND REFERENCES

1. Janeway, C.A., Travers, P., Walport, M. &Shlomchk, M.J. "Immunobiology", 6th Edition, Churchill, Livingstone, 2005.
2. Male, D., Brostoff, J., Roth, D. &Roitt, I. "Immunology", 7thEdition, Elsevier, 2006.
3. Mycek M.J., Garnet S.B and Perper M.M. "Lippincott's Illustrated Pharmacology Reviews", Lippincott Company, Philadelphia, 6th Edition, 2014.
4. Goodman and Gilman's, The Pharmacological basis of therapeutics, McGraw-Hill Education / Medical; 13th edition, 2017.
5. Katzung, B.G., Basic and Clinical Pharmacology, 13th Edition, McGraw Hill 2015.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Understand the diseases impacted in the domain of humoral / cellular immune responses.	2	2	2	2	2	2	–	–	–	–	–	2
CO2	Learn the pharmacology of drugs affecting the immune system and vice versa.	2	2	2	2	3	2	–	–	–	–	–	2
CO3	Learn the research strategies of developing and evaluating immunotherapeutics for emerging diseases.	3	3	3	3	3	3	2	2	2	1	3	3
Overall CO		3	3	3	3	3	3	1	1	1	–	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BT5251	ADVANCES IN ANIMAL BIOTECHNOLOGY	L T P C
		3 0 0 3

OBJECTIVES

The course aims to,

- appreciate how recombinant animals can be used for the production of importance of proteins.
- understand the technology to improve native and wild breeds to preserve the genome

UNIT IINTRODUCTION **4**

Scope of Animal Biotechnology, Animal Biotechnology for production of regulatory proteins, blood products, vaccines, hormones and other therapeutic proteins.

UNIT IIMOLECULAR BIOLOGY **9**

Biology of animal viral vectors- SV40, adenovirus, retrovirus, vaccinia virus, herpes virus, adeno associated virus and baculovirus.

UNIT IIICELL CULTURE TECHNOLOGY **11**

Culturing of cells, primary and secondary cell lines, Cell culture-Scaling up of animal cell culture-monolayer culture, suspension culture; Various bioreactors used for animal cell culture-Roller bottle culture; Bioreactor process control, stirred animal cell culture, Air-lift fermentor, Chemostat/Turbidostat; High technology vaccines: Hybridoma technology; Cell lines and their applications

UNIT IVGENETIC ENGINEERING **11**

Gene therapy-prospects and problems; Knockout mice and mice model for human genetic disorder; Baculovirus in biocontrol; Enzymes technology, Somatic manipulation of DNA, Nucleic acid hybridization and probes in diagnosis- preparation of probes, evaluation and applications.

UNIT VAPPLICATIONS **10**

Rumen manipulation- probiotics embryo transfer technology, in vitro fertilization, transgenesis-methods of transferring genes into animal oocytes, eggs, embryos and specific tissues by physical, chemical and biological methods; Biopharming - Transgenic animals (Mice, Cows, Pigs, Sheep, Goat, Birds and Insects); Artificial insemination and embryo transfer, cryopreservation and CRISPR.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to,

CO1 have knowledge in animal biotechnology.

CO2 use molecular biology tools for viral vector based gene delivery.

CO3 understand scaling up cell culture in industry.

CO4 know the uses of genetic engineering in animal biotechnology.

CO5 Apply animal biotechnology knowledge in livestock industry.

TEXTBOOKS AND REFERENCES

1. Watson, J.D., Gilman, M., WitowskiJ.and Zoller, M. “Recombinant DNA”, W. H. Freeman, 3rd edition, 2007.
2. Glick, B.R. and Pasternack, J.J. “Molecular Biotechnology”, 3rd edition, ASM Press, 2003.
3. Lewin, B. “Genes VIII”, Pearson Prentice Hall, 2004.
4. Davis J.M. “Basic Cell Culture: A Practical Approach”, IRL Press, 2002.
5. Freshney R.I. “Animal Cell Culture- a practical approach”, 1987.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	have knowledge in animal biotechnology	1	1	1	-	1	-	-	2	-	-	2	-
CO2	use molecular biology tools for viral vector based gene delivery	2	3	1	2	3	-	-	-	-	-	-	-
CO3	understand scaling up cell culture in industry	3	2	3	1	2	-	2	-	-	-	-	2
CO4	know the uses of genetic engineering in animal biotechnology	2	3	2	1	3	-	2	2	2	-	-	-
CO5	Apply animal biotechnology knowledge in livestock industry.	3	2	2	2	3	2	2	2	2	-	-	2
Overall CO		2	2	2	1	2	1	1	1	1	-	1	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BP5211	IMMUNOPHARMACOLOGY LABORATORY	L T P C
		0 0 63

OBJECTIVES

The course aims to,

- provide hands-on-experience on handling animal for research and various relevant immunological techniques like ELISA, Flow cytometry etc.,
- provide practical experience on performing and understanding immunoassays for evaluating drugs and vaccines.

LIST OF EXPERIMENTS

1. Selection and Handling of animals used in immunopharmacological assays (Eg. Mice, Rat, Rabbit, Zebra fish, *Caenorhabditis elegans* etc.,).
2. Preparation of antigens and immunization procedures for raising anti-sera.
3. Demonstration of various methods of bleeding, serum separation and storage.
4. Antibody titre by ELISA method (Indirect ELISA).
5. Sandwich ELISA – Quantification of antigens.
6. Immunoprecipitation/Immunoelectrophoresis.
7. Isolation and purification of IgG from serum (Ammonium sulphate method/Protein A).
8. Studies for characterisation of antigens - SDS -PAGE, Immunoblotting, Dot blot assays.
9. Assay for immunostimulants (Erythropoietin assay etc.,).
10. Direct Agglutination – Widal test, Salmonella detection.
11. Separation of mononuclear cells by Ficoll-Hypaque.
12. Separation and culturing of splenocytes and demonstration of T cell proliferation.
13. PBMC proliferation/cell viability by mitogen/antigen byMTT or Thymidine uptake assay.
14. Flow Cytometry – Identification of lymphocytes and their subsets.
15. Evaluation of monoclonal antibodies for diagnostic and therapeutic applications.
16. Demonstration of Immunodiagnostics using commercial kits (Rapid Flow through and Lateral flow devices – Dot Blot and StripTest).

TOTAL : 90 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to,

CO1 learn the principles of immunoassays employed in academic research.

CO2 learn how to perform the immunopharmacological assays used in the evaluation of vaccines and immunotherapeutics.

CO3 learn how to handle methods of planning and performing immunological techniques required in industries.

TEXT BOOKS AND REFERENCES

1. "Antibodies", Cold Spring Harbour Laboratory, 1988.
2. Goldsby, R.A. et al."Kuby Immunology". 6th Edition, W.H. Freeman, 2002.
3. Turgeon, Mary Louise. "Immunology and Serology in Laboratory Medicine", 2nd Edition, Elsevier, 2007.
4. Brostoff J et al., "Clinical Immunology", 6th Edition, Gower Medical Publishing, 2002.
5. Coligan, J. E. et al, "Current Protocols in Immunology", 4thEdition John Wiley & Sons, 1994.
6. Paul, "Fundamental of Immunology", 4th Edition, Lippincott Raven, 1999.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	learn the principles of immunoassays employed in academic research.	3	2	3	1	2	-	2	-	-	-	-	2
CO2	learn how to perform the immunopharmacological assays used in the evaluation of vaccines and immunotherapeutics	2	3	2	1	3	-	2	2	2	-	-	-
CO3	learn how to handle methods of planning and performing immunological techniques required in industries.	3	2	2	2	3	2	2	2	2	-	-	2
Overall CO		3	3	2	2	3	2	2	1	1	-	-	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BP5212 **MINI PROJECT WITH SEMINAR** **L T P C**
0 1 2 2

OBJECTIVES

The course aims to

- encourage the students to get connected with relevant industries/laboratory/research institutes
- acquire knowledge on solving practical problems, gaining work experience and skills
- learn the basics of research methodologies in academic/industrial/research environment

The students individually undergo training in reputed companies/research institutes/ organizations for the specified duration

COURSE OUTCOMES

At the end of the course the students will be able to
CO 1learn methods and procedures from industrial/academic/research institute
CO2 gain experience to work as an member in industrial or research team for
CO 3 acquire practical knowledge and enhance skills

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course outcome Statements		Programme outcomes (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	learn to work in an industrial/academic/research institute	1	3	2	3	3	3	2	3	2	3	2	3
CO2	gain experience to work as an individual as well as a member of a team	1	3	2	3	3	3	2	3	2	3	2	3
CO3	acquire practical knowledge and enhance skills	1	3	2	3	3	3	2	3	2	3	2	3
Overall CO		1	3	2	3	3	3	2	3	2	3	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

(Students are expected to do mini project and present seminars along with report on mini project.)

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESER III

BT5361 SOPHISTICATED ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY LABORATORY

L T P C
0 0 6 3

OBJECTIVES

The course aims to,

- acquaint students with skills needed for understanding the theory, operation and applications of sophisticated analytical laboratory instruments used in biotechnological academia and industries.
- educate the students in handling sophisticated instruments used in analytical biotechnology.

LIST OF EXPERIMENTS

1. Estimation of DNA/protein concentration by conventional and NanoDrop methods.
2. Preparative and qualitative estimation of biomolecules by HPLC analysis.
3. Evaluation of proteins by SDS-PAGE and Western blot (Chemiluminescence and Fluorescence detection methods).
4. Evaluation of proteins by 2D Gel electrophoresis (demo).
5. Protein mass determination by MALDI-TOF analysis- demo.
6. Determination of pathogens by Mass spectrometry.
7. Analysis by Real-time PCR (SYBR green method) with melting curve analysis.
8. Determination of protein aggregation by Dynamic Light Scattering (DLS).
9. Evaluation of cells by Confocal microscopy.
10. FTIR analysis of biomolecules.
11. GC-MS on small molecule analysis- demo.
12. Flow cytometry analysis of cell cycle- demo.

TOTAL : 90 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to,

CO1 Experience basic and widely used techniques in the analysis of biomolecules.

CO2 Experience overall techniques associated with proteomics such as protein separation by 2D-gel and characterization using mass spectrometer.

CO3 Experience fluorescence based real-time PCR, cell/tissue confocal imaging and separation using flow cytometer.

TEXT BOOKS AND REFERENCES

1. Skoog, D.A., West, D.M., and Holler, F. “Fundamentals of Analytical Chemistry”, 7th Edition. Brooks Cole, 2015.
2. Primrose S.B., Twyman R.H., and Old R.W. “Principles of Gene Manipulation”, 6th Edition., Blackwell Science, 2001.
3. Chapman J. R. “Mass Spectrometry of Proteins and Peptides” (Methods in Molecular Biology – Vol 146) Humana Press. 2000.
4. Simpson R. J. “Proteins and Proteomics - A Laboratory Manual”, Cold Spring Harbour Laboratory Press, 2002.
5. Rosenberg I. M. “Protein analysis and Purification – Benchtop Techniques”, Springer, 2005.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	experience basic and widely used techniques in the analysis of biomolecules	3	3	2	3	3	2	2	-	-	-	-	-
CO2	experience overall techniques associated with proteomics such as protein separation by 2D-gel and characterization using mass spectrometer	3	3	2	3	3	2	2	-	-	-	-	-
CO3	experience fluorescence based real-time PCR, cell/tissue confocal imaging and separation using flow cytometer	2	3	3	2	2	3	3	3	1	-	-	2
Overall CO		3	3	2	3	3	2	2	1	-	-	-	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BP5311 **ANIMAL BIOTECHNOLOGY LABORATORY** **L T P C**
0 0 6 3

OBJECTIVES

The course aims to,

- learn the techniques of culturing animal cell lines.
- understand the fundamentals of preservation and propagation of animal cell lines

LIST OF EXPERIMENTS

1. Preparation of media and sterilization techniques for animal cell culture.
2. Preparation of primary cell culture.
3. Preparation of continuous Cell lines (Eg. CHO, cancer cell lines, SP2O, etc).
4. Staining of Animal Cells and Cell Counting.
5. Viability of animal cells by MTT assay.
6. Various methods of cell perseveration and propagation.
7. Transfection of animal cell vectors (Eg. pBUD, pVAXetc) in mammalian expression system.
8. Cultivation of recombinant CHO cell lines in bioreactor.
9. Cell separation from medium by centrifugation, filtration.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

10. Purification and concentration of recombinant proteins by ammonium sulphate / aqueous two- Phase methods.
11. Evaluation of post-translational modification by SDS-PAGE-Shiff staining and other methods.
12. Demonstration of hybridoma fusion and propagation.
13. Cultivation of monoclonal antibodies in bioreactor.
14. Expression and purification of prototype therapeutic proteins insect cell lines.
15. Culture of virus in chick embryo.

TOTAL : 90 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 Have exposure on basic cell culture techniques.

CO2 Learn developing of recombinant cell lines, expression and purification of expressed protein.

CO3 Learn large-scale cultivation of cell lines in bioreactor and production of therapeutic protein.

CO4 Have exposure on basic virology and culturing virus in cell line and chick embryo.

CO5 Have complete understanding of Animal Biotechnology that will be useful in biopharmaceutical industries.

TEXT BOOKS AND REFERENCES

1. Animal Cell Culture and Technology, The Basics, Garland Science, 2nd Edition, Talylor and Francis, 2004.
2. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005.
3. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press, 2000.
4. Ed. Martin Clynes, Animal Cell Culture Techniques., Springer, 1998.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	have exposure on basic cell culture techniques.	2	1	2	1	-	1	1	-	-	-	-	2
CO2	learn developing of recombinant cell lines, expression and purification of expressed protein.	2	1	2	2	2	1	1	-	-	-	1	2
CO3	learn large scale cultivation of cell lines in bioreactor and production of therapeutic protein.	3	2	2	2	2	1	1	-	1	-	1	2
CO4	have exposure on virology and culturing virus in cell line and chick embryo	3	1	2	2	2	1	1	-	-	-	1	2
CO5	have complete understanding of Animal Biotechnology that will be useful in biopharmaceutical industries.	3	3	1	1	3	1	1	-	3	-	-	2
Overall CO		3	2	2	2	2	1	1	-	1	-	1	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BP5312 COMPUTATIONAL METHODS IN PHARMACEUTICS LABORATORY L T P C
1 0 4 3

OBJECTIVES

The course aims to,

- introduce pharma related databases, 3D structures of drugs, small molecules and targets
- get familiarized with Next Generation Sequencing Data analysis in a disease context
- perform Quantitative Structure Activity Relationship, Molecular Docking and simulations

LIST OF EXPERIMENTS

1. Introduction to Multiuser Operating System Linux.
2. Databases : Biological and Pharma related.
3. Computing molecular properties of drugs / compounds.
4. Molecular modeling of small molecules : obtaining 3D structures, understanding data formats.
5. Drug targets, Data resources and PDB structures.
6. Homology modeling of Protein Targets and Model evaluation.
7. Next Generation Sequencing Data Analysis Bioconductor Package for Differential gene expression analysis using a disease related dataset.
8. Quantitative Structure Activity relationship (QSAR) Model Pharmacophore identification.
9. Drug like property evaluation of compounds and ADME (Lipinski's rule of five).
10. Methodology of building and refining protein drug targets structure models from X-ray crystallographic data using CCP4i.
11. Molecular docking : Protein – Protein, Protein-Small Molecule.
12. Molecular Dynamics Simulation using GROMACS.
13. Pharmacogenomics : Effect of SNPs / mutations on drug binding using docking approaches.

TOTAL :75 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 retrieve data related to small molecules, drugs and their targets, use computational tools for their analysis.
CO2 perform basic next generation sequencing data analysis.
CO3 perform computational structural studies like QSAR, Molecular docking, Molecular Dynamics simulations and interpret the results.

TEXTBOOKS AND REFERENCES

1. Introduction to Bioinformatics by Arthur K. Lesk, Oxford University Press.2014
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.2004
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison, Cambridge University Press,1998
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press. 2004
5. Bioinformatics The Machine Learning Approach by Pierre Baldi and SorenBrunak, Cambridge University Press,2001
6. RNA-seq Data Analysis: A Practical Approach, by EijaKorpelainen, JarnoTuimala, PanuSomervuo, Mikael Huss and Garry Wong. CRC Press 2014
7. Next Generation Sequencing Data Analysis, by Xinkun Wang CRC Press.2016

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Retrieve data related to small molecules, drugs and their targets, use computational tools for their analysis.	2	3	3	2	3	–	–	–	–	–	–	–
CO2	Perform basic next generation sequencing data analysis	2	3	3	2	3	–	–	–	–	–	–	–
CO3	Perform computational structural studies like QSAR, Molecular docking, Molecular Dynamics simulations and interpret the results	2	3	3	2	3	–	–	–	–	–	–	–
Overall CO		3	2	3	3	2	3	–	–	–	–	–	–

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BP5313 **PROJECT PHASE I** **L T P C**

0 0 126

OBJECTIVES

This course aims to,

- Make the students identify a problem/process relevant to their field of interest that can be carried out
- Make them equipped to search databases and journals to collect relevant data and identify a solution
- Plan, learn and perform experiments to verify the solution

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 Identify the field of interest towards research/industrial problems

CO2 Equip the students to search and think about logical solutions

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Identify the field of interest towards research/industrial problems	2	3	2	2	1	2	-	2	2	1	1	2
CO2	Equip the students to search and think about logical solutions	2	3	2	2	1	2	-	2	2	1	1	2
Overall CO		2	3	2	2	2	1	-	2	2	2	1	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

SEMESTER IV

BP5411 **PROJECT PHASE II** **L T P C**

0 0 24 12

OBJECTIVES

The course aims to,

- Train students to analyze a problem/ think innovatively to develop new methods/product /process
- Make them understand how to find solutions/ create products economically and in an environmentally sustainable way
- Enable them to acquire technical and experimental skills to validate the solution, analyze the results and communicate
- Enable them to effectively think about strategies to commercialize the product

COURSE OUTCOMES

At the end of the course the student will be able to,

CO1 Formulate and analyze problems for developing new methods/solutions/processes.

CO2 Plan experiments to find solutions in a logical manner/ work out sustainability

CO3 Analyze the results, interpret and communicate/strategies for commercialization

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Formulate and analyze a problem/ create a new product/process	1	3	2	2	2	1	-	2	2	2	1	1
CO2	Plan experiments to find solutions in a logical manner/ work out sustainability	2	3	2	2	2	1	-	2	2	2	1	1
CO3	Analyze the results, interpret and communicate / strategies for commercialization	2	3	2	2	2	1	-	2	2	2	1	1
Overall CO		2	3	2	2	2	1	-	2	2	2	1	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

ELECTIVES

BP5072 BIOGENERICS AND BIOPHARMACEUTICALS L T P C
3 0 0 3

OBJECTIVES

The course aims to,

- Introduce the students about biogenerics and biosimilars and their characterization using analytical methods.
- Correlate the conceptual learning of biopharmaceuticals with their therapeutic equivalence using case studies.

UNIT I BIOGENERICS INTRODUCTION 9

Definition: Generics and its advantages; Biogenerics and Biosimilars; why biosimilars are not (bio) generics; The advent of Biosimilars; The role of patents in the drug industry; Protein-based biopharmaceuticals; Manufacturing processes; Global market; International Non-proprietary Names (INN) nomenclature system biosimilars regulation (EU position, US pathways, Government initiatives)

UNIT II BIOSIMILARS AND ITS SCENARIO 9

Approved follow-on proteins/Biosimilars; Characteristics of high selling peptides and proteins,; Products with expired patents; Challenging originator's patents; Target products for FOB (follow-on biologics) /Biosimilars development peptides; Recombinant Non Glycosylated proteins; Recombinant glycosylated proteins; Industries dealing with biogenerics and its market value; World scenario; Indian scenario.

UNIT III CHARACTERIZATION OF BIOSIMILARS 9

Approaches to the characterization of biosimilars; Problems in characterizing biologics(Types of biologic, Peptides, Non-glycosylated proteins, Glycosylated proteins, Monoclonal antibodies); Equivalence issues; Post-translational modifications; Effect of microheterogeneity; Pharmacokinetics; Pharmacodynamics; and Clinical efficacy; Analytical Methods for the characterization of biosimilars (Chromatography, Protein sequencing, Mass Spectrometry, UV absorption, Circular dichroism, X-ray techniques, Nuclear magnetic resonance, Electrophoresis, Western blotting, Bioassays, ELISA, Immunoprecipitation and other procedures)

UNIT IV IMMUNOGENICITY OF BIOPHARMACEUTICALS 9

Immunogenicity of biopharmaceuticals: Immunogenicity; Factors contributing to immunogenicity, (product-related factors and host-related factors), consequence of immunogenicity to biopharmaceuticals; Measurement of immunogenicity.

UNIT V CASE STUDIES 9

Case studies: Erythropoietin, Insulin, Somatotropin, Interleukin-2, Interferon Granulocyte-macrophage-CSF, DNase, Factor VIIa, Factor IX, Factor VIII, Activated protein C, Tissue plasminogen activator, Monoclonal antibodies etc., Immunogenicity of biopharmaceuticals: Immunogenicity; Factors contributing.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 acquire knowledge about biopharmaceutical production.

CO2 update with the regulatory aspects of biosimilars.

CO3 learn about production and characterization of biopharmaceuticals.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXTBOOKS AND REFERENCES

1. Niazi, Sarfaraz K. “Handbook of Biogeneric Therapeutic Proteins: Regulatory,Manufacturing, Testing, and Patent Issues”. CRC Press, 2006.
2. Ho, Reedney J. Y., MiloGibaldi. “Biotechnology & Biopharmaceuticals TransformingProteins and Genes into Drugs”, 2nd edition, 2013.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	acquire knowledge about biopharmaceutical production	1	1	1	-	1	1	1	-	-	-	-	2
CO2	update with the regulatory aspects of biosimilars	1	1	1	-	1	1	1	-	-	-	-	2
CO3	learn about production and characterization of biopharmaceuticals	1	1	1	-	1	1	1	-	-	-	-	2
Overall CO		1	1	1	-	1	1	1	-	-	-	-	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BP5001 ADVANCES IN OMICS SCIENCES AND TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

The course aims to,

- provide advanced theoretical knowledge on the organization and function of genome
- understand the principles of functional genomic analyses
- have knowledge on the advanced methods and approaches in proteomics.

UNIT I MICROARRAYS IN GENOMICS 9

Designing and producing microarrays; types of microarrays; cDNA microarray technology; Oligonucleotide arrays; Sample preparation, labeling, hybridization, generation of microarray data. Transcriptomics using cDNA and oligonucleotide arrays.

UNIT II NEXT GENERATION SEQUENCING TECHNOLOGIES 9

Overview of Next Generation Sequencing (NGS) technologies; Principles of NGS by Roche/454, Illumina, Life Technologies, Pacific Biosciences, Ion Torrent technologies; Applications of NGS to disease diagnosis and personalized medicine.

UNIT III PROTEIN MICROARRAYS AND YEAST TWO-HYBRID SYSTEM 9

Types of protein arrays; Protein microarray fabrication; Experimental analysis of proteins arrays.Data acquisition and processing; Applications of protein microarray types.Principles and methods in yeast two-hybrid system, Advances in yeast two hybrid system and its applications.

UNIT IV TWO-DIMENSIONAL GEL ELECTROPHORESIS OF PROTEINS 9

Sample preparation, First-dimension IEF with IPG; Second dimensional separation of proteins; Image analysis of 2-DE gels; DIGE, Protein expression profiling and comparative proteomics of complex proteomes using 2-DE.

UNIT V MASS-SPECTROMETRY 9

Basics of Mass-spectrometry (MS) and bimolecular analysis; Common ionization methods for peptide/protein analysis; Principles of Time of Flight (TOF), Ion Trap (IT), and Orbitrap mass analyzers; Mass spectrometry based proteomics: MALDI-TOF, Nano-LC-MS; Gas-chromatography coupled to Mass spectrometry; Mass-spectrometry analysis of Post-Translational Modifications of proteins.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 understand the designing and application of microarray.

CO2 have knowledge in next generation sequencing technologies and their use in diagnosis and personalised therapy.

CO3 have exposure to protein analysis using high end technology such as MALDI-TOF, and 2D gel Electrophoresis.

TEXTBOOKS AND REFERENCES

1. Schena M. (2000) DNA Microarrays - A Practical Approach. Oxford University Press.
2. Rinaldis E. D. and Lahm A (2007) DNA Microarrays. Horizon bioscience. Causton,H.C.
3. Muller H. J. and Roder T. (2006) Microarrays. Elsevier Academic Press.
4. Causton H. C., Quackenbush J., and Brazma A. (2004) A Beginner's Guide.
5. Schena M. (2005) Protein Microarrays. Jones and Bartlett Publishers.
6. O'Connor C. D. and Hames B. D. (2008) Proteomics. Scion Publishing Ltd.
7. Hoffman E. D. and Stroobant V. (2007) Mass Spectrometry – Principles and Applications,John Wiley & Sons Ltd.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	understand the designing and application of microarray.	3	2	1	1	3	1	-	-	1	-	-	2
CO2	have knowledge in next generation sequencing technologies and their use in diagnosis and personalised therapy.	3	2	1	1	3	3	-	-	1	-	-	2
CO3	have exposure to protein analysis using high end technology such as MALDI-TOF, and 2D gel Electrophoresis.	3	2	1	1	3	2	-	-	1	-	-	2
Overall CO		3	2	1	1	3	2	-	-	1	-	-	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BT5012 MOLECULAR PATHOGENESIS OF INFECTIOUS DISEASES L T P C
3 0 0 3

OBJECTIVES

The course aims to,

- Learn about advanced information on molecular pathogenesis of infectious diseases.
- Learn about the molecular mechanism of different pathogens.

UNIT I INTRODUCTION 5

Discovery of microscope Molecular Koch's postulates, concepts of disease, Virulence, Pathogenic cycle, Vaccines and its historical perspective, Biofilms, quorum sensing, multidrug resistance.

UNIT II HOST DEFENSE AGAINST PATHOGENS AND BACTERIAL DEFENSE STRATEGIES 10

Skin, mucosa, cilia secretions, physical movements, physical and chemical barriers to bacterial colonization, Mechanism of killing by humoral and cellular defenses, Complement, Inflammatory process, Phagocytosis, Colonization, Adherence, Iron acquisition mechanisms, Bacterial defense strategies.

UNIT III MOLECULAR MECHANISMS OF VIRULENCE 10

Virulence, Colonization factors, Microbial toxins, Secretion systems: General secretory pathway,Two-step secretion, Contact dependent secretion, Conjugal transfer system and Autotransporters.

UNIT IV MECHANISMS UNDERLYING MOLECULAR PATHOGENESIS (COMMON ENTERIC PATHOGENS) 10

Shigella: Entry, Induction ofmacropinocytosis, Invasion of epithelial cells, Intracellular Motility and spread, Apoptotic killing of macrophages, Virulence factors involved. ***E.coli***:Enterotoxigenic*E.coli*(ETEC), labile & stable toxins, Entero-pathogenic *E.coli* (EPEC), typeIII secretion, Cytoskeletal changes, intimate attachment; Enterohemorrhagic.coli (EHEC), Mechanism of bloody diarrhea and Hemolytic Uremic Syndrome, Enteroaggregative*E.coli*(EAEC). **Vibrio Cholerae:** Cholera toxin, Co-regulated pili, filamentous phage, survival.

UNIT V MECHANISMS UNDERLYING MOLECULAR PATHOGENESIS (COMMON NON-ENTERIC PATHOGENS) 10

Mycobacterium tuberculosis: The Mycobacterial cell envelope, Route of entry, Uptake By Macrophages, Latency and persistence, Entry into and survival in phagocytes, Immune Response against MTB, MTB virulence factors, Emergence of resistance. **Influenza Virus:** Intracellular stages, Neuraminidase and Haemagglutinin in entry, M1 & M2 protein in assembly and disassembly, action of amantadine. **Plasmodium:** Life Cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parastiparous vacuoles and knob protein transport, Antimalarial based on transport processes.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 obtain knowledge on the interaction of host and the pathogens.

CO2 know evasion strategies of pathogen against host defence.

CO3 understand how to develop the preventive measures and probable treatment strategies for infectious diseases.

TEXT BOOKS AND REFERENCES

1. Salyers, Abigail A. “Bacterial Pathogenesis: A Molecular Approach” American Society for Microbiology; 2nd Revised edition edition, 2002.
2. Groisman, “Principles of Bacterial Pathogenesis” Academic Press; 1 st edition 2001.
3. Waksman, Gabriel and Michael caparon “Structural Biology of Bacterial Pathogenesis”. American Society for Microbiology, 1st edition, 2005.
4. Clark, Virginia L. “Bacterial Pathogenesis” 1st edition, 1985.
5. Williams, Peter “Bacterial Pathogenesis” (Methods in Microbiology), 1st editon, 1988.
6. McClane, Bruce A. “Microbial Pathogenesis”1st edition, 1999.
7. Madigan, Michael T. “Biology of Microorganisms”, 13th edition, 2010.
8. Stanley, “Genetic analysis of Pathogenic Bacteria”, 2002.
9. Hacker, Jorg “Molecular Infection Biology”, 2002.

Course articulation matrix:

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	obtain knowledge on the interaction of host and the pathogens.	-	3	2	2	2	-	-	-	2	-	-	2
CO2	know evasion strategies of pathogen against host defence.	-	3	2	2	2	-	-	-	2	-	-	2
CO3	understand how to develop the preventive measures and probable treatment strategies for infectious diseases	-	3	2	2	2	-	-	-	2	-	-	2
Overall CO		-	3	2	2	2	-	-	-	2	-	-	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BT5072 **ENZYME ENGINEERING AND TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to,

- Teach principles of enzyme engineering and enzyme technology.
- Learn about immobilisation techniques and kinetics in enzyme technology.

UNIT I ENZYMES, COENZYMES AND COFACTORS 9

Enzymes: Enzyme as biological catalysts; activation energy, specificity, Enzyme action, active site, enzyme substrate complex, cofactors, Classification, Source of enzymes; production, isolation and purification of enzymes; Characterization in terms of pH, temperature, ionic strength, substrate and product tolerance, effects of metal ions; Coenzymes and cofactors: Coenzymes, classification of vitamins, role and mechanism of action of some important coenzyme (NAD+/NADP+, FAD, lipoic acid, tetrahydrofolate,B12-coenzyme), role of cofactors with specific examples.

UNIT II ENZYME KINETICS 9

Methods for investigating the kinetics of Enzyme catalysed reactions – order of reaction, initial velocity studies. Michaelis-Menten equation, Km and Vmax, enzyme inhibition; methods of plotting enzyme kinetics data; Enzyme turnover number, Solution of numerical problems. competitive, non-competitive, uncompetitive, irreversible; order of reaction,methods of plotting enzyme kinetics data; determination of Kcat, Km, Vmax, Ki, Half Life, effect of pH and Temperature on enzyme activity Multi Substrate enzymes and kinetics mechanisms; Enzyme induction, repression, covalent modification, Isoenzymes, allosteric effects.

UNIT III ENZYME ENGINEERING 9

Introduction, Random and rational approach of protein engineering; Directed evolution and its application in Biocatalysis; various approaches of creating variant enzyme molecules; Future of Biocatalysis; Ideal biocatalyst.

UNIT IV IMMOBILIZED ENZYME TECHNOLOGY 9

Different techniques of immobilization of enzymes and whole cells; Advantages and disadvantages of immobilization; Cross linked enzymes, enzyme crystals, their use and preparation Kinetics of immobilized enzymes, design and operation of immobilized enzymes reactors; Type of reactors, classification, retention of enzymes in a reactor, kinetics of enzyme reactors; Reactor performance with inhibition, operation of enzyme reactors; case studies; Application and future of immobilized enzyme technology

UNIT V ENZYMATIC TRANSFORMATION 9

Functional group interconversion using enzymes (hydrolysis reaction, oxidation/reduction reactions, C-C bond formations).Reaction engineering for enzyme-catalyzed biotransformations.Catalytic antibodies.Biocatalysts from extreme Thermophilic and Hyperthermophilic microorganisms (extremozymes). The design and construction of novel enzymes, artificial enzymes, Biotransformation of drugs (hydroxylation of Steroids), Host Guest Complexation chemistry, enzyme design using steroid templates, enzymes for production of drugs, fine chemicals and chiral intermediates.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 know about basics such as enzyme's classification, action and factors affecting its activity.

CO2 get knowledge about enzyme kinetics and different types of enzyme inhibition.

CO3 have exposured to various approaches of enzyme engineering and immobilization.

CO4 learn the applications of enzymes.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXTBOOKS AND REFERENCES

1. Stryer, L. (2002). Biochemistry. Freeman. New York.
2. Lehninger, A. L. (2004). Principles of Biochemistry (4th ed.). Worth. New York, NY.
3. Voet, D., &Voet, J. G. (2004). Biochemistry (4th ed.). Wiley & Sons. Hoboken, NJ: J
4. Rehm, H. & J. Reed, G., (1986). Enzyme Technology. Volume 7a. John Wiley & Sons.
5. Irwin H. Segel, (1976). Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry, 2nd revised Ed. John Wiley & Sons.
6. Biotol, (1992). Bioreactor Design & Product Yield. Butterworth-Heinemann.
7. Wang, D. I. C. (1979). Fermentation and Enzyme Technology. Wiley. New York.
8. Trevor Palmer , Enzymes IIndHorwood Publishing Ltd. 2007
9. Faber K ,Biotransformations in Organic Chemistry, IV edition , Springer. 2018.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	know about basics such as enzyme's classification, action and factors affecting its activity.	3	1	1	1	1	-	-	-	1	-	-	2
CO2	get knowledge about enzyme kinetics and different types of enzyme inhibition.	3	1	2	1	1	-	-	-	1	-	-	2
CO3	have exposure to various approaches of enzyme engineering and immobilization.	3	1	2	1	3	-	1	1	1	-	2	2
CO4	learn the applications of enzymes.	3	1	2	1	1	-	1	1	1	-	2	2
Overall CO		3	2	2	1	2	-	1	1	1	-	1	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BP5002	BIOCONJUGATE TECHNOLOGY AND APPLICATIONS	L T P C 3 0 0 3

OBJECTIVES

The course aims to,

- Provide advanced theoretical knowledge on Bio conjugate technologies in Biopharmaceutical Applications .
- Learn about bioconjugate applications in immune based cells and enzymes.

UNIT I FUNCTIONAL TARGETS 9

Modification of Amino Acids, Peptides and Proteins – Modification of sugars,polysaccharides and glycoconjugates – modification of nucleic acids and oligonucleotides.

UNIT II CHEMISTRY OF ACTIVE GROUPS 9

Amine reactive chemical reactions – Thiol reactive chemical reactions – carboxyl reactive chemical reactions – hydroxyl reactive chemical reactions – aldehyde and ketone reaction chemical reactions – Photoreactive chemical reactions.

UNIT III BIOCONJUGATE REAGENTS 9

Zero length cross linkers – Homo bifunctional crosslinkers – Hetero bifunctional cross linkers – Trifunctional cross linkers – Cleavable reagent systems – tags and probes.

UNIT IV ENZYME AND NUCLEIC ACID MODIFICATION AND CONJUGATION 9

Properties of common enzymes – Activated enzymes for conjugation – biotinylated enzymes– chemical modification of nucleic acids – biotin labeling of DNA- enzyme conjugation toDNA – Fluorescent of DNA.

UNIT V BIOCONJUGATE APPLICATIONS 9

Preparation of Hapten-carrier Immunogen conjugates - antibody modification and conjugation – immunotoxin conjugation techniques – liposome conjugated and derivatives-Colloidal – gold labeled proteins – modification with synthetic polymers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 understand bio-molecules target and their active groups for conjugation.

CO2 get knowledge about different types of bio-conjugate reagents.

CO3 have exposured to conjugation of enzymes, antibody and nucleic acid and the application of the conjugated product.

TEXTBOOKS AND REFERENCE

1. Hermanson, G.T. “Bioconjugate Techniques”. Academic Press 3rd edition, 2013.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	2	3	4	5	6	7	8	9	10	11	12
CO1	understand bio-molecules target and their active groups for conjugation.	3	2	1	1	3	1	-	-	1	-	-	2
CO2	get knowledge about different types of bio-conjugate reagents.	3	2	1	1	3	3	-	-	1	-	-	2
CO3	have exposure to conjugation of enzymes, antibody and nucleic acid and the application of the conjugated product.	3	2	1	1	3	2	-	-	1	-	-	2
Overall CO		3	2	1	1	3	2	-	-	1	-	-	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BP5003 CHEMISTRY OF NATURAL PRODUCTS L T P C
3 0 0 3

OBJECTIVES

The course aims to,

- enhance theoretical knowledge of students in the chemistry of natural products
- explore this knowledge for practical applications.

UNIT I CARBOHYDRATES AND RELATED COMPOUNDS 9

Sugars and sugar – containing drugs polysaccharides and polysaccharide –containing drugs cellulose gums and mucilages, pectin

UNIT II GLYCOSIDES AND TANNINS 9

Biosynthesis of glycosides, Phenol and alcohol glycosides, anthraquinone glycosides,cyanophore glycosides, saponin glycosides, cardiac glycosides, isothiocyanate flavonol lactone glycosides tannins volatile oils, resins and resin combinations.

UNIT III ALKALOIDS AND ALICYCLIC COMPOUNDS 9

Pyridine and piperidine alkaloids, Tropane alkaloids, QuinolineAlka Kids, isoquinoline alkaloids, Indole alkaloids, Imidazole alkaloids, Steroidal alkaloids, Alkaloidal amines purine bases.Terpenes, camphor, menthol, carotenes.

UNIT IV VITAMINS, PURINES, FLAVONOIDS 9

Chemistry, medicinal and pharmaceutical uses of vitamin A, D, E, K, B_1, B_2, B_6, B_{12} and Folic Acid.Chemistry and structural elucidation of uric acid, interrelation between caffeine, theophylline and theobromine.Classification and application of flavonoids (hespiridineetc).

UNIT V MOLECULES FROM NATURAL SOURCES 9

Classification of Drug molecules of Plant/marine/microbial and animal sources - cytotoxic / antineoplastic agents, cardiovascular drugs - antimicrobial substances – anti-inflammatory and antispasmodic agents.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 have knowledge on phytoconstituents.

CO2 have an insight about natural product based drugs.

CO3 have knowledge on dietary supplements.

TEXTBOOKS AND REFERENCES

1. Evans, W.C., 'Trease and Evans Pharmacognosy', 15th Edition, Saunders, 2002.
2. Wallis, T.E. "Textbook of Pharmacognosy", 5th Edition, CBS Publishers, 2005.
3. Kokate, C.K. "Pharmacognosy", 29th Edition, NiraliPrakashan, 2004.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	have knowledge on phytoconstituents	1	1	-	-	-	-	1	-	-	-	-	2
CO2	an insight about natural product based drugs	1	1	-	-	-	-	1	-	-	-	-	2
CO3	have knowledge on dietary supplements	1	1	-	-	-	-	1	-	-	-	-	2
Overall CO		1	1	-	-	-	-	1	-	-	-	-	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BP5073	CLINICAL TRIALS AND BIOETHICS	L T PC 3 0 0 3

OBJECTIVES

The course aims to,

- Provide fundamental learning about clinical trial management in drug development and project management in clinical trials.
- Learn about pharmacovigilance, quality control and ethical management in clinical research.

UNIT I INTRODUCTION TO CLINICAL TRIALS 9

Fundamentals of clinical trials; Basic statistics for clinical trials; Clinical trials in practice; Reporting and reviewing clinical trials; Legislation and good clinical practice - overview of the European directives and legislation governing clinical trials in the 21st century; International perspectives; Principles of the International Committee on Harmonisation (ICH)-GCP.

UNIT II REGULATIONS OF CLINICAL TRIALS 9

Drug development and trial planning - pre-study requirements for clinical trials; Regulatory Approvals for clinical trials; Consort statement; Trial responsibilities and protocols - roles and responsibilities of investigators, sponsors and others; Requirements of clinical trials protocols; Legislative requirements for investigational medicinal products.

UNIT III MANAGEMENT AND ETHICS OF CLINICAL TRIALS 9

Project management in clinical trials - principles of project management; Application in clinical trial management; Risk assessment; Research ethics and Bioethics - Principles of research ethics; Ethical issues in clinical trials; Use of humans in Scientific Experiments;Ethical committee system including a historical overview; informed consent; Introduction To ethical codes and conduct; Introduction to animal ethics; Animal rights and use of animals in the advancement of medical technology; Introduction to laws and regulations regarding the use of animals in research.

UNIT IV INFORMED CONSENT 9

Consent and data protection- the principles of informed consent; Consent processes; Data Protection; Legislation and its application; Data management – Introduction to trial master files and essential documents; Data management.

UNIT V QUALITY CONTROL AND GUIDELINES 9

Quality assurance and governance - quality control in clinical trials; Monitoring and audit;Inspections; Pharmacovigilance; Research governance; Trial closure and pitfalls-trial closure; Reporting and legal requirements; Common pitfalls in clinical trial management.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 acquire knowledge about the fundamentals, various statistics, practicing and reviewing of clinical trials.
CO2 know about guidelines and regulation of clinical trials of new drugs.
CO3 understand project management in clinical trials and about various ethical issue while conducting clinical trials.
CO4 manage the output data obtained from clinical trials and maintain quality in clinical trials.

TEXTBOOKS AND REFERENCES

1. Lee, Chi-Jen; etal., “Clinical Trials or Drugs and Biopharmaceuticals.” CRC / Taylor & Francis, 2011.
2. Matoren, Gary M. “The Clinical Research Process in the Pharmaceutical Industry.” Marcel Dekker, 1984.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	acquireknowledge about the fundamentals, various statistics, practicing and reviewing of clinical trials.	2	1	1	-	-	-	-	-	2	-	-	-
CO2	know about guidelines and regulation of clinical trials of new drugs.	2	1	1	-	-	-	-	2	2	-	-	-
CO3	understand project management in clinical trials and about various ethical issue while conducting clinical trials.	2	1	2	-	-	-	-	3	2	-	3	-
CO4	manage the output data obtained from clinical trials and maintain quality in clinical trials.	2	2	2	1	1	-	-	2	2	-	-	-
Overall CO		2	1	2	1	1	-	-	2	2	-	1	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BP5004 CONVENTIONAL AND RATIONAL DRUG DISCOVERY STRATEGIES L T P C
3 0 0 3

OBJECTIVES

The course aims to,

- expose the students to various principles and methodologies involved in the drug discovery and validation process.
- provide an insight about in-silico based drug discovery from natural sources

UNIT I FUNDAMENTALS ON RATIONAL DRUG DESIGN 9

Various approaches in drug discovery process – conventional versus rational, drug targets, lead identification; Principles of ligand chemistry – lead optimization, pharmacophores, bioisosteres, principles of ligand chemistry such as configuration, conformation, chirality, isosteric replacement; Parameters of ligand design such as –Phytochemical, geometric, conformational, topological, partitional, steric, stereochemical and electronic properties of drug molecules; Pharmacokinetic parameters of ligand design such as - lipinski “rule of 5”, partition coefficient, hammetcontant, hansch analysis. biological, chemical and physical descriptors used in qsar and qspr. statistical methods used for analysing QSAR/ QSPR data

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT II IN-SILICO AND SIMULATION METHODOLOGIES IN DRUG DISCOVERY 9

Introduction to molecular docking (including methods and scoring functions), de novo pharmacophore elucidation/ drug design for structurally well-defined receptor targets from case studies (Eg. HIV protease inhibition, ACE inhibition); Principles of macromolecule-ligand docking, docking algorithms, AUTODOCK; Molecular dynamic simulations, relative energy, energy minimization methods, ligand binding free energy calculations (both simulation and empirical methods), intermolecular interactions, forces related to drug binding, force-field calculations including solution, role of solubility in drug binding and pKa, Poisson-Boltzmann Surface Area (PBSA), AMBER,GROMOS and GROMACS.

UNIT III COMBINATORIAL AND SYNTHETIC PEPTIDE LIBRARIES 9

Combinatorial Chemistry in drug development, Biopolymers as natural libraries, Selection and evolution of expression genetic libraries, Combinatorial assembly of antibody genes, Molecular solutions to Combinatorial problems, Solid-Phase peptide synthesis, Peptide on pins, Other iterative deconvolution strategies,Examples of Split/Couple/Mix Peptide Libraries, Positional Scanning., Polystyrenes, Grafted supports, Coupling strategies, linkers, Supported Solution and Phase Synthesis, analytical methods for solid-phase.

UNIT IV HIGH THROUGHPUT SCREENING IN DRUG DISCOVERY 9

Classification of HTS: Protein based biochemical screens, methods of analytical biochemistry used in HTS (photometry, purification, electrophoresis, kinetic assay,radioisotopes, immunoassay, HTS FACS based assays). Assay design for HTS and statistical treatment of the results for decision. Introduction to state of the art technologies used in HTS (including automated liquid handling machines (robots), Microfluidic Tools for HTS, Miniaturization); preclinical toxicological studies, Correlation between in-vitro and in-vivo screens, case studies on pharmacological screening models for therapeutic areas such as hypertension, Parkinson's disease, Alzheimer's disease, diabetics, parasitic diseases

UNIT V GENETIC BASED TOOLS IN DRUG DISCOVERY PROCESS 9

Basics of gene silencing, transgenic worms in drug screening; designing SiRNAs, Types ofRNAi Screens – Loss of Function screens (LOF), Synthetic Lethal screen, Mini-clonogenic RNAi screen; optimizing, and implementing high-throughput siRNA genomic screening for the discovery of survival genes and novel drug targets, siRNA HTS Screening for identification of targeted pathways in biological systems. Microarray technologies – Classification with microarrays and class prediction, Visualization and functional analysis. Bio molecular pathways, gene ontology, genome browsing, Gene expression biology, microarray platforms, design of experiments, file structures and data storage (Eg.Affymetrix); Preprocessing of microarray data for Image analysis, quality control and array normalization.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 learn about different rational drug discovery strategies.

CO2 know about molecular modelling in drug development.

CO3 understand the Gene based tool and high throughput screening methods.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS AND REFERENCES

1. Williams, D.A. and Lemke, T.L., "Foye's Principles for Medicinal Chemistry" 5th Edition, Lippincott, Williams & Wilkins, 2002.
2. Leach, AR, "Molecular Modeling & Drug Design", 2nd Edition, John Willy, 2000.
3. GROMOS and GROMACS Manuals.
4. Murray, K.J. "Principles and Practice of High Throughput Screening". Blackwell Scientific Publishers, 2004.
5. Ye, S., and Day, I.N.M. "Microarrays and Microplates: Applications in Biomedical Sciences". BIOS 2003.
6. "Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry".12th Edition, Lippincott-Raven Publisher, 2010.
7. Fassina, G. "Combinatorial Chemistry and Technologies: Methods and Applications", 2nd Edition, CRC Press, 2005
8. Block J.H. and Beale, J.M., 'Wilson & Gisvolds Textbook of Organic Medicinal and Pharmaceutical Chemistry', 11th Edition, Lippincott Williams & Wilkins, 2004.
9. Janzen W. P. "High Throughput Screening: Methods and protocols". Humana Press. 2002.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	learn about different rational drug discovery strategies	2	1	1	1	1	-	-	-	-	-	-	2
CO2	Know about molecular modelling in drug development	2	1	1	1	1	-	-	-	-	-	-	2
CO3	Understand the gene based tool and high throughput screening methods	2	1	1	1	1	-	-	-	-	-	-	2
Overall CO		2	1	1	1	1	-	-	-	-	-	-	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BP5005	METABOLIC PROCESS AND ENGINEERING	L T P C 3 0 0 3

OBJECTIVES

The course aims to,

- familiarize the student with quantitative approaches for analyzing cellular metabolism and the use of theoretical and experimental tools that can give insights into the structure and regulation of metabolic networks.
- identify the optimal strategy for introducing directed genetic changes in the microorganisms with the aim of obtaining better production strains.

UNIT I METABOLIC FLUX ANALYSIS 9

Introduction to metabolic engineering, comprehensive models of cellular reactions with stoichiometry and reaction rates; metabolic flux analysis of exactly/over/under determined systems. Shadow price, sensitivity analysis.

UNIT II TOOLS FOR EXPERIMENTALLY DETERMINING FLUX THROUGH PATHWAY 9

Monitoring and measuring the metabolome, Methods for the experimental determination of metabolic fluxes by isotope labeling metabolic fluxes using various separation –analytical techniques. GC-MS for metabolic flux analysis, genome wide technologies: DNA /phenotype microarrays and proteomics.

UNIT III CONSTRAINT BASED GENOMIC SCALE METABOLIC MODEL 9

Development of Genomic scale metabolic model, in-silico Cells: studying genotype-phenotype relationships using constraint-based models, case studies in E. coli, S.cerevisiae metabolic network reconstruction methods, optimization of metabolic network, Identification of targets for metabolic engineering; software and databases for genome scale modeling.

UNIT IV METABOLIC CONTROL ANALYSIS AND KINETIC MODELING 9

Fundamental of Metabolic Control Analysis, control coefficients and the summation theorems, Determination of flux control coefficients. Multi-substrate enzyme kinetics,engineering multifunctional enzyme systems for optimal conversion, and a multi scale approach for the predictive modeling of metabolic regulation.

UNIT V CASE STUDIES IN METABOLIC ENGINEERING 9

Metabolic engineering examples for bio-fuel, bio-plastic and green chemical synthesis. Study of genome scale model in various systems for the production of green chemicals using software tools. Validation of the model with experimental parameters.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 understand the fundamentals of metabolic engineering.

CO2 learn experimental tools for determination of metabolic fluxes.

CO3 develop *in-silico* genome-scale metabolic model.

CO4 have experience in metabolic engineering with exposure to various case studies.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS AND REFERENCES

1. Stephanopoulos, G.N. “Metabolic Engineering: Principles and Methodologies”. AcademicPress / Elsevier, 2012.
2. Lee, S .Y. and Papoutsakis, E.T. “Metabolic Engineering”. Marcel Dekker, 1999.
3. Nielsen, J. and Villadsen, J. “Bioreaction Engineering Principles”. Springer, 2007.
4. Smolke, Christiana D., “The Metabolic Pathway Engineering Handbook Fundamentals”,CRC Press Taylor & Francis, 2010.
5. Voit, E.O. “Computational Analysis of Biochemical Systems: A Practical Guide forBiochemists and MolecularBiologists”. Cambridge University Press, 2000.
6. Scheper, T. “Metabolic Engineering” Vol 73 (Advances in Biochemical Engineering Biotechnology) Springer, 2001.
7. Cortassa, S. et al, “ An Introduction to Metabolic and Cellular Engineering”, WorldScientific Publishing, 2002.
8. Kholodenko, Boris N and H. V. Westerhoff “Metabolic Engineering in the Post GenomicEra”, Horizon Bioscience, 2004.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	understand the fundamentals of metabolic engineering	3	2	1	-	1	-	-	-	1	-	1	1
CO2	learn experimental tools for determination of metabolic fluxes	3	3	3	3	3	-	-	-	1	-	1	1
CO3	Develop *in-silico* genome scale metabolic model.	3	3	2	1	3	-	-	-	1	-	1	1
CO4	have experience in metabolic engineering with exposure to various case studies.	3	3	2	2	1	-	-	-	1	-	1	1
Overall CO		3	3	2	2	2	-	-	-	1	-	1	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BP5074 **MOLECULAR MEDICINE AND MECHANISM** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to,

- understand the molecular mechanism of the disease and advanced understanding of drug interactions.
- learn the molecular organisation of different organ systems and its functions.

UNIT I INTRODUCTION TO MOLECULAR MEDICINE 9

Organization of the Human Genome, Chromosomes and Genes – Recombinant DNA and Genetic Techniques – Transcriptional Control of Gene Expression – transmission of HumanGenetic Disease –Human Genome Project – Cell Cycle Oncogenes and Tumor suppressorGenes – Molecular Diagnostic Testing – Genetic Counseling – Transgenic Mice as Models of Disease, Introduction to gene therapy.

UNIT II CARDIOLOGY 9

MolecularCardiologyCongenitalHeartDisease–InheritedCardiomyopathies–
CoronaryAtherosclerosis – Endothelium – Derived Nitric Oxide and Control of Vascular Tone – Hypertension – Cardiac Arrhythmias – Cardiovascular Gene Therapy.

UNIT III PULMONOLOGY 9

Asthma – Cystic Fibrosis – Pulmonary Emphysema – Surfactant Deficiency – Lung Cancer:The Role of Tumor Suppressor Genes – Strategies for controlling the diseases.

UNIT IV ENDOCRINOLOGY 9

Mechanisms of Hormone Action – Diabetes Mellitus – Pituitary Function and Neoplasia Hormone Deficiency- Disorders –Thyroid Disorders – Disorders of the parathyroidGland – Congenital Adrenal Hyperplasia– Adrenal Disease – Multiple Endocrine Neoplasia Type, Mechanisms of Hypoglycemia Associated with increasedInsulinProduction.

UNIT V NEPHROLOGY 9

Renal Development – Mechanisms of Leukocyte Extravasation – Ischemic Acute Renal Failure – Potassium Secretory Channels in the Kidney – Alport Syndrome – Nephrogenic Diabetes Insipidus – Polycystic Kidney Disease – Renal Neoplasms: Wilms' Tumor and Renal-Cell Carcinoma.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 learn about the human genome, molecular diagnostic testing and gene therapy.

CO2 learn about various physiological systems in the human body and genetic disease associated to them.

CO3 understand the molecular mechanism of the treatments for these genetic disease.

TEXT BOOKS AND REFERENCES

1. Jameson, J. L., Francis, S.C., "Principles of Molecular Medicine", Human Press, 1998.
2. Ross, D.W. "Introduction to Molecular Medicine", 3rd Edition, Springer, 2002.
3. Ross, D.W. "Introduction to Oncogenes and Molecular Medicine", Springer, 1998.
4. Pasternak, J.J. "An Introduction to Human Molecular Genetics", 2nd Edition, Wiley Liss, 2005.
5. Strachan, Tom and Andrew P. Read. "Human Molecular Genetics, Bios, 1996.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	learn about the human genome, molecular diagnostic testing and gene therapy.	3	2	1	-	-	-	-	-	1	-	-	2
CO2	learn about various physiological systems in the human body and genetic disease associated to them.	3	2	1	-	-	-	-	-	1	-	-	2
CO3	Understand the molecular mechanism of the treatments for these genetic disease.	3	2	1	-	3	-	-	-	1	-	-	2
Overall CO		3	2	1	-	1	-	-	-	1	-	-	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BT5073 **NANOBIOTECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

The course aims to,

- provide fundamental concepts of nanotechnology.
- use the fundamental knowledge for the application of nanotechnology to biological sciences including nanomedicine.

UNIT I NANOSCALE AND NANOBIOTECHNOLOGY 9

Introduction to Nanoscience and Nanotechnology; Milestones in Nanotechnology; Overview of Nanobiotechnology and Nanoscale processes; Physicochemical properties of materials in Nanoscales.

UNIT II FABRICATION AND CHARACTERIZATION OF NANOMATERIALS 9

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials ;Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.

UNIT III PROPERTIES AND MEASUREMENT OF NANOMATERIALS 9

Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

UNIT III PROPERTIES AND MEASUREMENT OF NANOMATERIALS 9

Properties of DNA and motor proteins; Lessons from nature on making nanodevices; Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Fabrication and application of DNA nanowires; Nanofluidics to solve biological problems.

UNIT V NANO DRUG DELIVERY AND NANOMEDICINE 9

Properties of nano carriers; drug delivery systems used in nanomedicine; Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Health and environmental impacts of nanotechnology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 Understand fundamental concepts of nanotechnology and nanomaterials
CO2 Have knowledge on the fabrication and characterization of nanomaterials
CO3 Understand nanobiology and modification of nanomaterials
CO4 Know nano-based drug delivery and nanomedicine

REFERENCES

1. Nanobiotechnology: Concepts, Applications and Perspectives, Christ of M. Niemeyer(Editor), Chad A. Mirkin (Editor) , Wiley-VCH; 1 edition, 2004.
2. Nano Biotechnology: BioInspired Devices and Materials of the Future by OdedShoseyovandIlan Levy, Humana Press; 1 edition 2007.
3. Nano Biotechnology Protocols (Methods in Molecular Biology) by Sandra J Rosenthal And David W.W right , Humana Press; 1 edition, 2005.
4. Bio-Nanotechnology Concepts and applications. Madhuri Sharon, Maheshwar Sharon,SunilPandey and Goldie Oza, Ane Books Pvt Ltd, 1 edition 2012.
5. Microscopy Techniques for Material Science. A. R. Clarke and C. N. Eberhardt (Editors) CRC Press. 1st Edition, 2002.

Course Articulation Matrix

course outcome statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	understand fundamental concepts of nanotechnology and nanomaterials	2					2				1		2
CO2	have knowledge on the fabrication and characterization of nanomaterials	3		2			2		1				2
CO3	understand nanobiology and modification of nanomaterials	2	2		1	1	2	2	1				3
CO4	know nano-based drug delivery and nanomedicine	3	2		1	1	2	2	2	1		1	3
Overall co		3	1	1	1	1	2	1	1	-	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BP5071	ADVANCES IN PHARMACOGENOMICS	L T P C 3 0 0 3

OBJECTIVES

The course aims to,

- provide knowledge about Pharmacogenomics and drug design using genomic applications.
- study the genome applications on drug action and toxicity.

UNIT I INTRODUCTION TO PHARMACOGENOMICS 9

Pharmacogenetics-The roots of pharmacogenomics, It is not just pharmacogenomics, Genetic drug response profiles, the effect of drugs on Gene expression, pharmacogenomics in drug discovery and drug development.

UNIT II THE HUMAN GENOME 9

Expressed sequence Tags (EST) and computational biology, Microbial genomics,computational analysis of whole genomes, computational genome analysis, Genomic Differences that affect the outcome of host pathogen interactions: A template for the future of whole genome-based pharmacological science.

UNIT III ASSOCIATION STUDIES IN PHARMACOGENOMICS 9

Viability and ADR in drug response: contribution of genetic factor, Multiple inherited genetic factors influence the outcome of drug treatments, Plasma binding proteins, Drug targets.

UNIT IV GENOMICS APPLICATIONS FOR DRUG ACTION AND TOXICITY 9

Genomics, Proteomics, Bioinformatics, The pharmaceutical process, applications of pharmaceutical industry, Understanding biology and diseases, Target identification and validation, Drug candidate identification and optimization.

UNIT V PHARMACOGENOMICS AND DRUG DESIGN 9

The need of protein structure information, protein structure and variation in drug targets-the scale of problem, Mutation of drug target s leading to change in the ligand binding pocket.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course the student will be able to,

CO1 learn about the human genome, gene expression and their effect on drug therapy and toxicity.

CO2 know about the influence of epigenetic on therapeutic outcome.

CO3 have a complete understanding about the fundamentals of pharmacogenomics and personalized medicine.

TEXTBOOKS AND REFERENCES

1. Licinio, Julio and Ma-Li Wong, “Pharmacogenomics: The Search for the Individualized Therapies”, Wiley-VCH, 2002.
2. Chiranjib Chakraborty and Atana Bhattacharyya, “Pharmacogenomics: An Approachto New Drugs Development”, 2004.
3. Rothstein, Mark, A. “Pharmacogenomics: Social, Ethical and Clinical Dimensions”, Wiley-Liss, 2003.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	learn about the human genome, gene expression and their effect on drug therapy and toxicity	3	2	1	1	1	-	-	-	1	-	-	2
CO2	know about the influence of epigenetic on therapeutic outcome.	3	2	1	1	1	-	-	-	1	-	-	2
CO3	have a complete understanding about the fundamentals of pharmacogenomics and personalized medicine.	3	2	1	1	1	-	-	2	1	-	-	2
Overall CO		3	2	1	1	1	-	-	1	1	-	-	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

BT5071 **APPLIED STATISTICS FOR BIOLOGISTS** **L T P C**
2 1 0 3

OBJECTIVES

The course aims to,

- Study the fundamentals of statistics.
- Apply the fundamentals of statistics in relation to biological and biotechnological problems.

UNIT I PROBABILITY **9**

Random variable-sample spaces-Events-Axiomatic approach to probability-conditional probability-additional theorem, Multiplication theorem -Bayes theorem problems-continuous and discrete random variables, Distribution function-Expectation with properties-Moments, mean, Variance problems-for continuous and discrete distributions.

UNIT II DISTRIBUTION **9**

Bivariate distribution-conditional and marginal distribution-Discrete distribution-Binomial, Poisson, geometric distribution-Continuous distribution, Normal, exponential and negative exponential, gamma distributions-simple problems-properties.

UNIT III METHODS OF CORRELATION **9**

Correlation coefficient, properties-problems-Rank correlation-Regression equations problems-curve fitting by the method of least squares-fitting curves of the form ax+b, ax^2+bx+c, ab^x and ax^b-Bivariate correlation application to biological problems.

UNIT IV SAMPLING **9**

Concept of sampling-Methods of sampling-sampling distributions and Standard Error-Small samples and large samples-Test of hypothesis-Type I, Type II Errors-Critical region-Large sample tests for proportion, mean-Exact test based on normal, t, f and chi-square distribution-problems-Test of goodness of fit.

UNIT V DESIGN OF EXPERIMENT **9**

Basic principles of experimentation - Analysis of variance-one-way, Two-way Classifications - Randomized block design, Latin square design - problems.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to,

CO1 Understand basic probability and distribution in statistics.

CO2 learn correlation and regression with sampling in biological experiments.

CO3 design experiments and justify the statistical significance of the results of the experiment in testing hypothesis.

CO4 Understand and apply statistical methods of analysis in biological research.

TEXT BOOKS AND REFERENCES

1. Kapoor, V. K. “Elements of Mathematical statistics”3rd edition,2002. .
2. Vittal, P.R. and V.Malini.”Statistical and Numerical Methods”. Margham Publications. 2012.
3. Veerarajan,T. “Probability, Statistics and Random Processes”.3rd Edition., Tata McGraw-Hill, 2008.
4. Johnson, R. A.”Miller& Freund’s Probability and Statistics for Engineers”. 6 ed. PHI, 2003.
5. Arora, P. N. SmeetArora, and Arora, S. “Comprehensive Statistical Methods”. S. Chand & Co,1997.
6. Spiegel, Murray R., J.Schiller and R. AluSrinivasan. ”Schaum’sOutlines Probability and Statistics”, 2nd Edition. Tata McGraw-Hill 2000.
7. Kandasamy, P. K. Thilagavathi& K. Gunavathi.”Probability Statistics and Queuing Theory”. S. Chand & Co., 2004.

Course Articulation Matrix

Course Outcome Statements		Programme Outcome (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	Understand basic probability and distribution in statistics.	3	-	-	1	-	-	-	-	-	-	-	-
CO2	learn correlation and regression with sampling in biological experiments.	3	3	3	2	-	-	-	1	1	-	-	1
CO3	design experiments and justify the statistical significance of the results of the experiment in testing hypothesis.	3	3	3	1	-	-	-	1	1	-	2	3
CO4	Understand and apply statistical methods of analysis in biological research.	3	3	3	2	-	-	-	1	1	-	3	3
Overall CO		3	3	3	2	-	-	-	1	1	-	1	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

BT5010 TECHNIQUES IN MOLECULAR BIOLOGY AND GENETIC ENGINEERING

L T P C
3 0 0 3

OBJECTIVES

The course aims to

- enlighten key molecular biology and genetic engineering techniques
- apply the latest techniques in current biological research as well as in biotechnology industries.

UNIT I VECTOR SYSTEMS 9

Overview of tools in recombinant DNA technology. Artificial chromosomes – YACs and BACs. Principles for maximizing gene expression – expression vectors, pMal, GST, pET-based vectors. Protein purification – His-tag, GST-tag and MBP-tag. Intein-based vectors; Inclusion bodies; methodologies to reduce formation of inclusion bodies; mammalian expression and replicating vectors; Baculovirus and Pichia vectors system, plant based vectors, Ti and Ri plasmids as vectors, yeast vectors, shuttle vectors.

UNIT II ASSAY TECHNIQUES IN MOLECULAR BIOLOGY 8

Nuclease protection assays, Nuclease S1 mapping, Reporter assays – Mono and dual reporter assays, Electrophoretic mobility shift assay (EMSA)/Gel shift assay, Run-off transcription assay, Phage display, Ribosome display, Gene silencing – siRNA and Morpholino.

UNIT III HIGH-THROUGHPUT DNA SEQUENCING 9

Preparation of Next Generation Sequencing (NGS) libraries: Fragmentation versus tagmentation, end repair, clonal amplification – Bridge PCR and emulsion PCR. Basics and steps involved in NGS platforms: Illumina/Solexa, Roche 454, Ion-torrent and Pacific biosciences. Current status of Oxford nanopore sequencing. Principles of Mate pair sequencing, ChIP-seq, RIP/CLIP-Seq, Methyl seq – Restriction enzyme, enrichment and bisulfite treatment strategies.

UNIT IV GENE EXPRESSION ANALYSIS 10

Overview of gene expression and its significance. Hybridization methods: Southern and Northern. PCR methods: Reverse transcriptase PCR, End point Vs. Real time PCR, Relative quantitation, Absolute quantification – Standard curve method and digital PCR. Endogenous/loading controls.High throughput analysis:Multiplex PCR, Microarray, Serial analysis of gene expression (SAGE) and Small Amplified RNA-SAGE (SAR-SAGE), Total analysis of gene expression (TOGA), Gene calling, RNA-seq and Ribosome profiling.

UNIT V GENOME EDITING TECHNOLOGIES 9

Basicsand applications of genome editing methods - Zinc-finger nuclease (ZFN), Transcription activator-like effector nucleases (TALEN), Meganucleases, CRISPR-Cas systems – Types and applications, Homing endonucleases, Transposons and Cre/lox P systems.Gene delivery systems – Physicochemical methods and viral vectors.

TOTAL :45 PERIODS

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OUTCOMES:

At the end of the course the students will be able to

CO1 understand strength and limitations of tools and techniques used in molecular biology and genetic engineering

CO2 understand basic principles and steps involved in DNA/RNA sequencing methods and current protocols of specific vs global gene expression analysis

CO3 understand the current techniques involved in gene editing to generate appropriate genetically modified organisms

REFERENCES

1. Steven R. Head, Phillip Ordoukhanian, Daniel R. Salomon. "Next Generation Sequencing: Methods and protocols"1st Edition, Humana Press, 2018
2. KrishnaraoAppasani. "Genome Editing and Engineering" Cambridge University press 2018.
3. Raghavachari Nalini, Garcia-Reyero Natàlia. "Gene expression analysis: Methods and protocols" 1st Edition, Humana Press, 2018.
4. Primrose SB and Twyman RB. "Principles of Gene manipulation and Genomics". 7th Edition, Wiley-Blackwell, 2006.
5. Green MR and Sambrook J. "Molecular Cloning: A Laboratory Manual". 4th Edition, CSHL press, 2012.

Course Articulation Matrix

Course outcome Statements		Programme Outcomes (PO)											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	understand strength and limitations of tools and techniques used in molecular biology and genetic engineering	3	3	3	2	3	3	3	1	1	-	-	3
CO2	understand basic principles and steps involved in DNA/RNA sequencing methods and current protocols of specific vs global gene expression analysis	3	3	3	2	3	3	3	1	1	-	-	3
CO3	understand the current techniques involved in gene editing to generate appropriate genetically modified organisms	2	3	3	2	2	3	3	3	1	-	-	2
Overall CO		3	3	3	2	3	3	3	1	1	-	-	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop– RDBMS versus Hadoop–Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop– Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. VigneshPrajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, UmeshaNayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	1
CO2	2	1	1	2	1	1
CO3	1	1	2	3	3	1
CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

OE5092 **INDUSTRIAL SAFETY** **LT P C**
3 0 0 3

OBJECTIVES:

Summarize basics of industrial safety
Describe fundamentals of maintenance engineering
Explain wear and corrosion
Illustrate fault tracing
Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn ,Foundation Engineering Handbook, Chapman & Hall London,2013.
4. Higgins & Morrow , Maintenance Engineering Handbook,Eighth Edition,2008

OE5093 OPERATIONS RESEARCH LT P C
3 0 0 3

OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation , assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method,Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:

CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094 COST MANAGEMENTOF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member,Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES

CO1 – Understand the costing concepts and their role in decision making CO2– Understand the project management concepts and their various aspects in selection CO3– Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095 COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identifythe various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, WestGermany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096 **WASTE TO ENERGY** **L T P C**
3 0 0 3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNITI INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNITIIBIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNITIII BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNITIV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNITV BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AUDIT COURSES (AC)

AX5091 ENGLISHFOR RESEARCHPAPERWRITING L T P C
2 0 0 0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNITI INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 –Learn about what to write in each section
CO3 –Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AX5092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION **6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA **6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **6**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT **6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company,2007.
3. Sahni, Pardeep Et.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS 6

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES 6

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AX5094	VALUE EDUCATION	L T P C
		2 0 0 0

OBJECTIVES

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Workethics,Indianvisionofhumanism.Moralandnon-moralvaluation.Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love fornature, Discipline

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.

Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the over all personality.

Suggested reading

1. Chakroborty, S.K.“Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

AX5095	CONSTITUTION OF INDIA	L T P C 2 0 0 0

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:

History, Drafting Committee, (Composition &Working)

UNIT II PHILOSOPHYOFTHE INDIANCONSTITUTION:

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION:

District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- DiscussthegrowthofthedemandforcivilrightsinIndiaforthebulkofIndiansbeforethe arrival of Gandhi in Indian politics.
- Discusstheintellectualoriginsoftheframeworkofargumentthatinformedtheconceptualization
- of social reform sliding to revolution in India.
- DiscussthecircumstancessurroundingthefoundationoftheCongressSocialistParty[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- DiscussthepassageoftheHinduCodeBillof1956.

Suggested reading

1. TheConstitutionofIndia,1950(BareAct), Government Publication.
2. Dr. S. N. Busi, Dr. B. R.AmbedkarframingofIndianConstitution,1st Edition,2015.
3. M.P. Jain,IndianConstitutionLaw,7th Edn.,Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis,2015.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

AX5096	PEDAGOGY STUDIES	L T P C 2 0 0 0

OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OFPEDAGOGICALPRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness soft he sepedagogical practices, in what conditions, and with what population of learners?
- How can teacher education(curriculum and practicum)and the school curriculum and guidance materials best support effective pedagogy?

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Suggested reading

1. Ackers, HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare,31(2): 245-261.
2. AgrawalM (2004)Curricular reform in schools: The importance of evaluation, JournalofCurriculumStudies,36(3):361-379.
3. AkyeampongK(2003)TeachertraininginGhana-doesitcount?Multi-siteteachereducationresearchproject(MUSTER) country report 1.London:DFID.
4. Akyeampong K,LussierK, PryorJ, WestbrookJ (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. ChavanM (2003) Read India: Amass scale, rapid, 'learningtoread 'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX5097 **STRESS MANAGEMENT BY YOGA** **L T P C**
2 0 0 0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do's and Don't'sin life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTEDREADING

1. 'YogicAsanasforGroupTarining-Part-I":JanardanSwamiYogabhyasiMandal, Nagpur
2. "Rajayogaorconquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department),Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To a waken wisdom in students

UNIT I

Neetishatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 -Personality of role model - shrimadbhagwadgeeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad- Bhagwad- Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and man kind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students.

Suggested reading

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.